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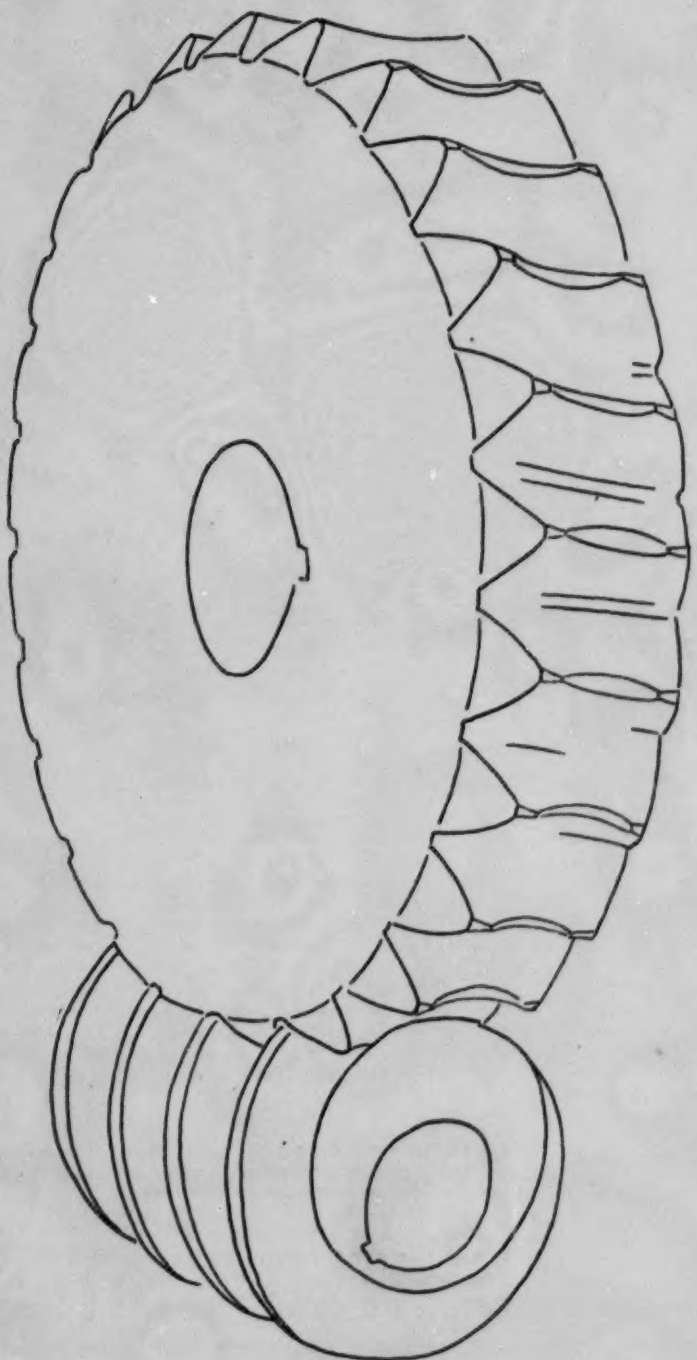

FEBRUARY, 1956
VOL. 21, NO. 5
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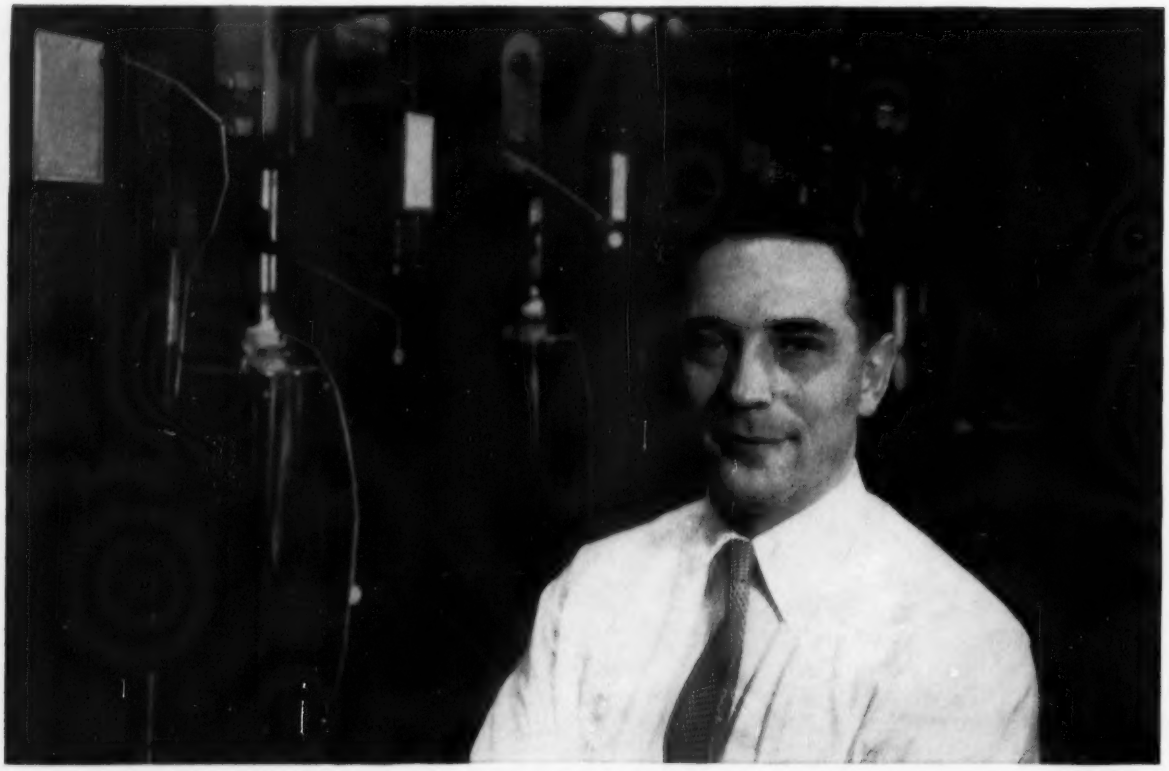

JOHN BAUSCHER graduated from college in 1943 with a B.S. degree in Metallurgy. After a stint in the Navy, he returned to college as a metallurgical research assistant. In 1949 he received his M.S. in Metallurgy and then came to work at the U.S. Steel Applied Research Laboratory. After just four and a half years, Mr. Bauscher had progressed to Division Chief for Sheet Products Development – responsible for the improvement of present sheet steel products and the development of new and improved types.

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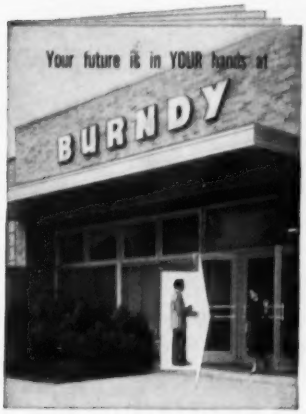

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FEBRUARY, 1956 VOLUME 21 NO. 5

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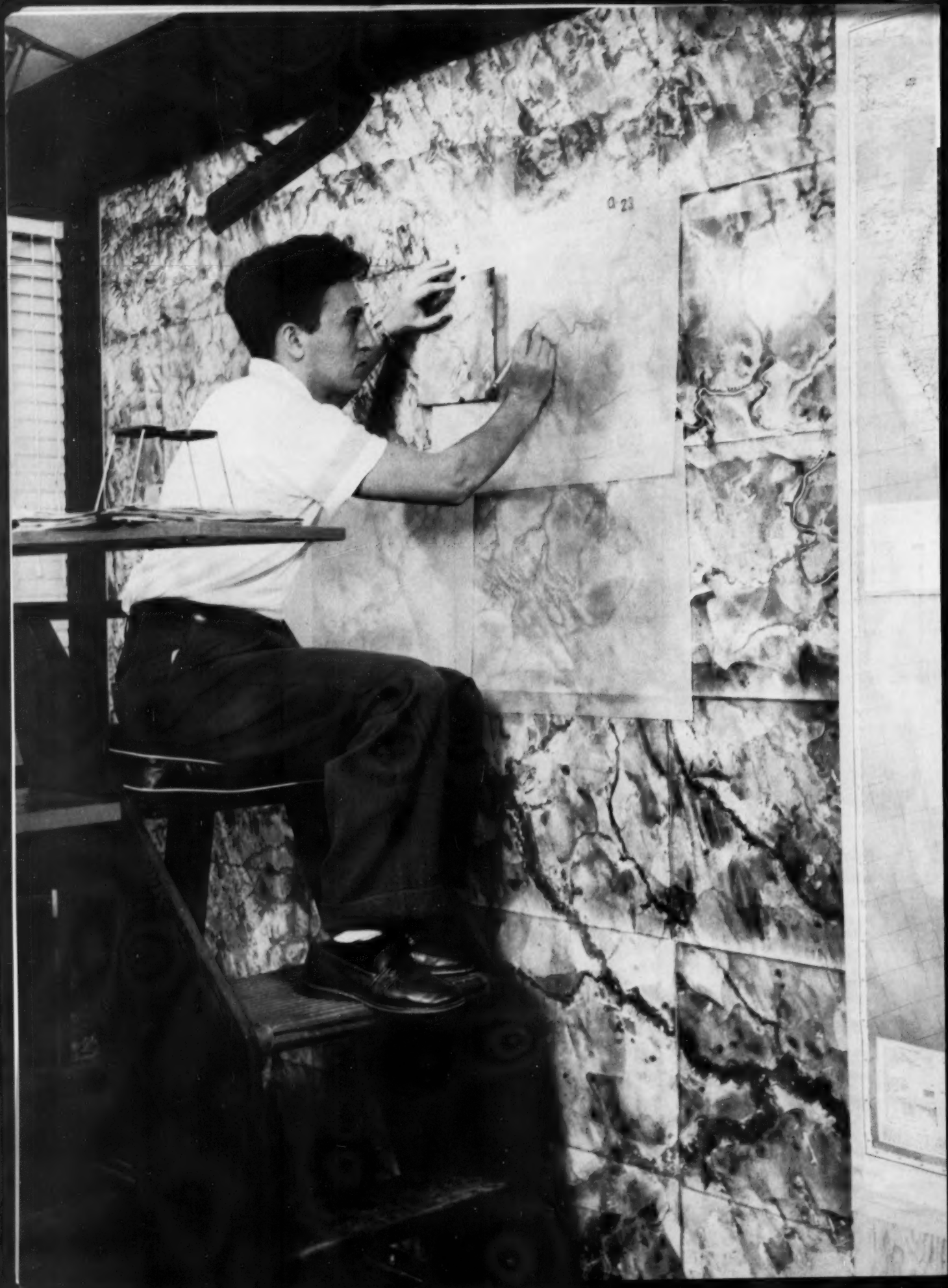


AERIAL PHOTOGRAPHIC INTERPRETATION

by

RALPH W. KIEFER, CE '56

A development of the past few decades which has the potential to become a universally used tool in virtually every phase of exploration of the earth's surface is the aerial photograph. Using commercially obtained stereo pairs of aerial photographs, usually 9 by 9 inches and to a scale of 1:20,000, a trained interpreter is able to draw conclusions about the nature of his study area which may be impossible to discover by other methods. He can thereby greatly reduce the amount and cost of field exploration work.

Largely through work at a few universities, and especially at Cornell, the applications of photo interpretation have expanded rapidly in the fields of geology, engineering, agriculture, forestry, city planning, and military intelligence. However, present techniques and uses of aerial photographic interpretation are recognized by an alarmingly small number of persons. The purpose of this article is to point out some of the methods of analysis and fields of application of this expanding science.

To set forth a definition, "aerial photographic interpretation" is the analysis of the elements and patterns of an aerial photograph or set of aerial photographs and an interpretation of the physical nature of the area under study. Photo interpretations are made in relation to some particular field of inquiry such as structural geology or engineering soils mapping, and may include the use of "photogrammetry," the science of making measurements from controlled aerial photographs.

Airphoto analyst interpreting topography on large mosaic of Brazil.

Method of Analysis

For the following discussion, let us assume that the desired end product of the analysis is an interpretation of the soils and rocks for engineering purposes. Analysis for other purposes would use most of the same techniques.

The photographs used for interpretation work are usually taken in strips with a 60 percent overlap between successive photographs of a strip to provide stereoscopic coverage. Adjacent flight paths overlap 15 percent or so to insure complete coverage of an area. The first step in the analysis of an area is to assemble an uncontrolled mosaic of the photographs to gain an overall impression of the area. Major areas of similar features are roughly outlined and then a detailed study is made by stereoscopic pairs. As he works, the interpreter marks upon the photographs with marking crayons or "grease pencils." After the analysis and interpretation is complete, a final drawing is made as required.

There are five "clues" which, when evaluated in the light of past experiences, will indicate the nature of the rocks and soils in the area. They are topography, drainage, erosion, photo tone, and vegetation and land use.

The topography is readily seen by a stereoscopic examination of the photos and is often the primary clue in the identification process. In an analysis of a glaciated region, the glacial land forms classified as "hilly" would include eskers, kames, moraines, and drumlins. Those classified as "level" would include till plains, outwash plains, terraces, and lake beds. An esker winding across a till plain could be identified and outlined almost entirely by topography.

The drainage in an area also helps to classify the landform present. In an area of sedimentary rocks, a dendritic (tree-like) drainage pattern indicates horizontally bedded rocks while a trellis drainage pattern (long roughly parallel major tributaries with short parallel tributaries perpendicular to and flowing into the major tributaries) indicates a region of strongly folded or steeply dipping beds. The number of streams in a given area indicates the nature of the rock and the texture of the soil in that area.

A valuable but sometimes neglected clue to the nature of the soil is that of erosion. A study of the plan, profile, and cross section of the gullies will predict the texture of the soil. Long, winding gullies with rounded edges indicate cohesive soils (clays) while short, steep gullies with a "V" shaped cross section indicate granular soils.

An evaluation of the color tone of the photograph with a proper regard for the climate of the area

—*D. J. Belcher*

Permafrost near Nome, Alaska. Soil "polygons are 40' by 60' across.

—*U.S. Department of Agriculture*

Limestone sinkho'es in Kentucky. Area shown is 1¼ miles wide.

will enable the interpreter to differentiate between the different soil types of an area. The exact shade of grey registered on the print depends upon the method of photo reproduction, the season of year, and the type of climate in addition to the texture of the soil. However, on an individual set of photographs, variations in tone indicate the variations in soil texture with the finer grained soils photographing dark and the coarser grained soils photographing light.

Though vegetation and land use vary greatly with the different climatic zones of the world, they will also aid in the identification process. An igneous dike cutting across sedimentary rocks may often be traced due to differences in vegetation. Land use may indicate soil textures with drainage ditches indicating poorly drained soils and orchards indicating well drained soils.

The only mechanical device which is generally used in the interpretation of photographs is a simple, ten dollar pocket stereoscope which enables the interpreter to see a three dimensional magnified image of the photographs. The skill with which an interpreter can analyze a set of photographs does not depend upon mechanical devices or his manual dexterity but rather upon his ability to analyze the photographs in light of his past experience and to evaluate and interpret what he sees.

Familiar Patterns

In addition to an analysis and interpretation by use of the five "clues" previously mentioned, often a quick identification can be made by recognizing a familiar pattern. The accompanying photograph titled "Permafrost near Nome, Alaska" is an oblique photograph taken from a low flying plane over the Seward Peninsula north of Nome, Alaska. The "soil polygons" clearly visible on this photograph indicate a condition which is found in much of that region and can be called a "familiar pattern." The series of parallel lines, which are not to be confused with the polygons, are man-made "cat tracks" left by an Army vehicle inspecting the area.

Basically, the permafrost region consists of an upper layer of soil several feet thick which is frozen in Winter and which thaws in Summer, and a sub-surface layer of soil which is frozen the entire year. A polygon pattern is formed in the upper layer which is thought to be the result of a stress adjustment to the seasonal expansion and contraction. The frozen surface breaks into the polygon pattern and during the summer the open cracks are filled with the melted ice water. In winter this water freezes and, in time, a continuous ice wedge is formed which may extend more than twenty feet below the surface of the ground. These wedges of ice cause many engineering headaches. If an airport runway is constructed across a wedge of ice, the heat absorbed by the pavement will melt the ice and the pavement will fail over the wedge with resulting development of cracks and holes. These soil polygons are readily visible on aerial photographs due to a difference in vegetation above the ice wedges. Aerial photographs can be used to advantage in location surveys in this region to avoid areas where severe damage might occur due to extreme thawing.

Another familiar pattern which can almost always be readily identified is that of limestone with well developed sinkholes. The lower right hand half of the illustration labeled "Limestone Sinkholes in Kentucky" shows the usual appearance of an area of soluble limestone containing many sinkholes. These sinkholes are the result of drainage through vertical solution channels which have formed in the limestone. Topographically they are expressed as depressions in the ground. The sinkholes, which appear lighter than the surrounding ground, have been plugged with fine materials and are now filled with water. Those appearing the same tone as the surrounding ground are still open and vertical drainage is still taking place. Those which appear darker than the surrounding ground are plugged with fine materials and wetter than the surrounding soil. The five clues can

be used to substantiate an original quick decision that the area is limestone. A topographic inspection shows the presence of depressions in the ground. There are no streams present on the photograph indicating that the drainage must be vertically downward through the soil and rock. No gullies can be seen on this photograph, but in some cases they can be seen encircling a sinkhole all directed toward its center. The tone of the photograph indicates that there are circular areas which have finer grained or else more poorly drained soil than the surrounding soil. The area is reasonably well farmed indicating that the depressions are not so deep as to drastically interfere with farming practices. The conclusions drawn by applying the five clues are all applicable to limestone areas and the original decision has been substantiated. Limestone can cause a good many engineering troubles in the location of factories, highways and airports. The sink-holes must be filled if crossed and future failure is likely to occur at those points. The upper left hand half of the photo does not have the same appearance as the part just discussed. This is a region of hills formed of layers of interbedded shale and limestone overlying the limestone that is present in the lower right hand half. It differs in topography, drainage, erosion, tone, and vegetation and land use from the pure limestone area. The rather sharp line of tree vegetation marks the division line between the overlying rocks and the exposed limestone.

Fields of Application

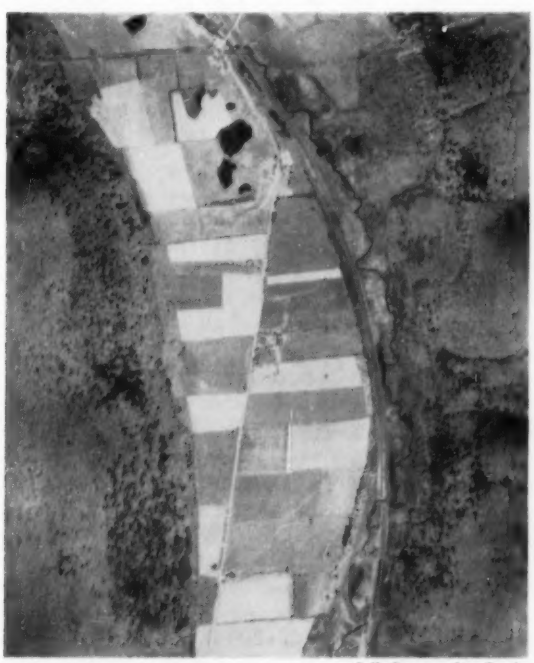
As previously mentioned, aerial photographs can be used in a number of occupations. In the following paragraphs, mention will be made of the applications to structural and glacial geology, airport location surveys, engineering soil surveys, and archeology. Aerial photographs can also be useful in mining geology, petroleum geology, forestry, agriculture, city and regional planning, engineering project planning, surveying, and military intelligence.

Structural Geology

The structural geologist spends a great portion of his time in the field making the measurements from which he will draw his conclusions about the structural relationships in the area—anticlines, synclines, faults, etc.—and from which he will construct his map of the area. Aerial photographs cannot completely replace field work in this case but they can greatly reduce it, and in some cases indicate the presence of structures that may go unnoticed in the field. The photographs serve as a base may for the area and help to increase the perspective of the field observer. Many inferences and perhaps conclusions about the structural characteristics of the area can be determined from the photographs alone. With the aid of photogrammetric principles, measurements can be made from the photographs and such things as the strike and dip of beds and the thickness of outcrops can be calculated in the office.

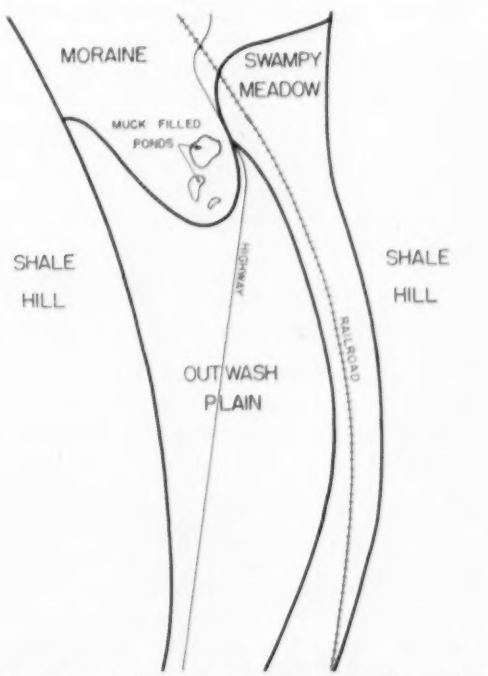
Glacial Geology

Aerial photographs are very useful in an analysis of glacial activity in an area. The photograph and accompanying diagram labeled "Glacial Outwash Plain in a Valley near Ithaca, New York" illustrates a situation common to a number of valleys in that part of the country. At one period of geologic history, a moraine was formed across the valley at a place labeled "moraine" on the diagram. As ice melted, the glacial melt water was impounded in a temporary lake behind the moraine in a position in the valley off the top of the photograph. In time, the lake broke through this dam and carried the morainic materials down the valley toward the bottom of the picture. The initial swift flow of water filled



—Soil Conservation Service

Glacial outwash plain in a valley near Ithaca, New York. Area shown is 1 mile wide.



Drawing shows geological features of area in photograph at left.

—*U.S. Department of Agriculture*

Glacial outwash plain in Minnesota. Area shown is 1¼ miles wide.

the entire width of the valley and deposited sands and gravels to a considerable depth forming an area known as "outwash plain."

An interpreter with an understanding of glacial action can reconstruct the sequence of glacial activity in areas such as this and outline the various glacial landforms. The border between the shale hill and the outwash plain can be mapped by considering either topography, tone, or vegetation and land use. A stereoscopic inspection will enable the border between the moraine and outwash to be seen. Present on the moraine are several muck filled ponds known as "kettles." These are quickly spotted because the fine grained muck and its associated vegetation photograph very dark. A great many outwash plains contain channel scars and ponds which have been filled with muck to a considerable depth. The next example illustrates an actual problem caused by a muck filled channel on an outwash plain.

Airport Location Survey

The photograph titled "Glacial Outwash Plain in Minnesota" is an example of a case in which a quick investigation by a trained person would have prevented a considerable amount of unnecessary expenditures. The C.A.A. was considering this site near Bemidji, Minnesota for the location of a new class A airport. The area is located on outwash and contains a muck filled channel almost a mile in length which can be seen in the center of the photograph. The muck filled channel appears as a uniform dark color and resembles a small lake on the photograph. The bearing capacity of this muck is unsuitable for any heavy construction and the site is not an economcal location for an airport.

Soil investigators were sent to make a soil survey of this site to determine if it was suitable for the construction of an airport. The field men took samples along the main roads encircling the channel, and made a cursory inspection of the fields. The topography is very flat, and nothing unusual was seen from their inspection. The muck filled deposit was completely unnoticed, and the men left the site satisfied that they had the proper samples to construct a soil map of the site. Laboratory testing of the samples collected showed the soils to be well suited to the construction work as outwash areas contain well drained rather granular soils with an excellent bearing capacity.

The airport was designed and the land purchased before the presence of the muck was pointed out to the authorities in a report by Professor D. J. Belcher (Director of the Airphoto Interpretation Center at Cornell) who had been called into the job. The location of the runways was somewhat altered but the airport was constructed on the site. At least one of the runways crossed the muck. It required a great deal of extra work to remove the muck which was present to a depth of thirty feet, and to backfill with suitable materials.

If aerial photographs had been consulted prior to the purchase and design, a more suitable site for the airport could have been chosen and the construction completed more economically.

Engineering Soil Surveys

An engineering soil survey has recently been completed for the entire State of New Jersey through the cooperation of the State Highway Department and Rutgers University. The technique used combines a careful laboratory examination of airphotos and a field sampling of soils.

To prepare the soil maps, the interpreter first outlines the boundaries of the different soil types on the photos by an analysis of the five clues previously mentioned, and makes an estimate as to the properties of the soil in each type. He then chooses representative sites within each type for a field investigation and after samples have been collected, they are tested in the lab and the various soil types classified. The information is transferred to the photos and a tracing made for the final map. Because of the careful choice of testing sites, the properties of the samples collected are assumed to be the same as all the soil of that type as outlined on the photo, a procedure which mini-

(Continued on page 53)

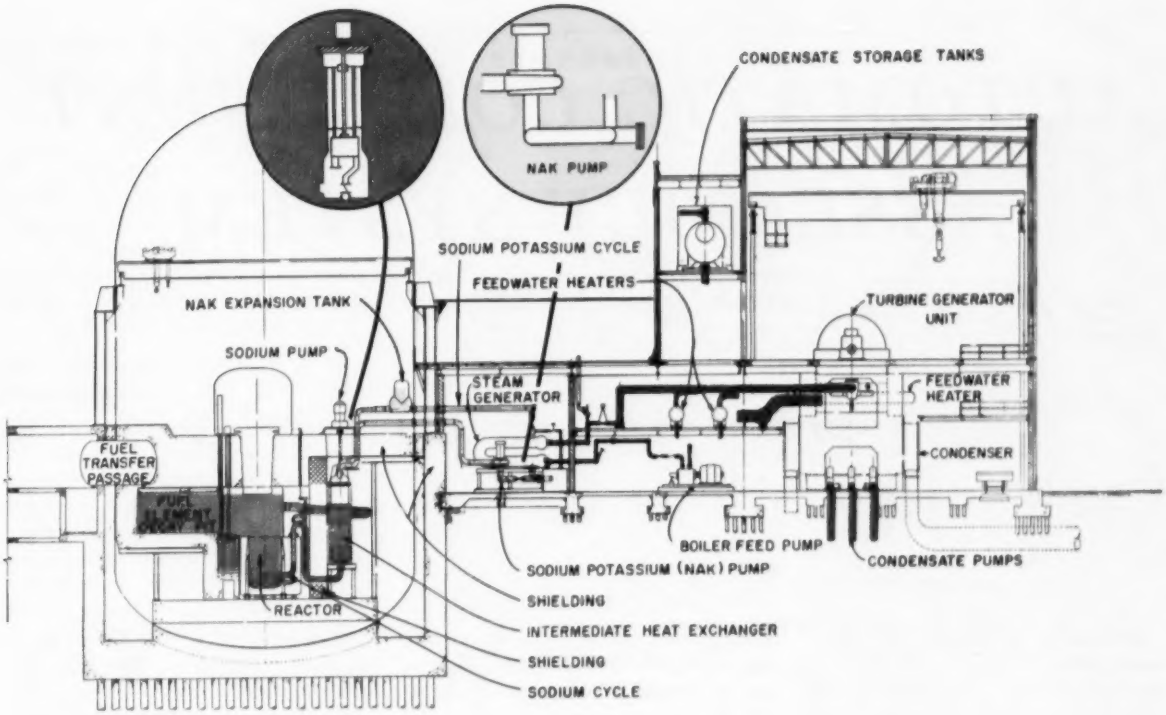


DIAGRAM OF STEAM POWER PLANT UTILIZING NUCLEAR ENERGY IN A FAST NEUTRON BREEDER REACTOR

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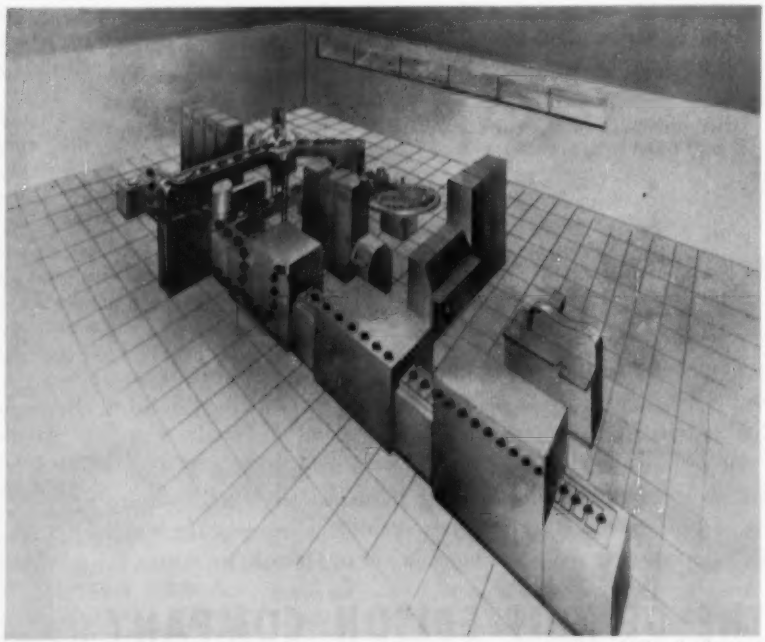
AUTOMATIC COMPONENT ASSEMBLY SYSTEM

by

RICHARD BRANDENBURG, ME '58

Automatic production of electronic sub-assemblies controlled by punched card programming makes automation a reality in the General Electric Automatic Component Assembly System. The System, occupying a 1200 square foot floor area, automatically prepares electrical components, tests them to their individual tolerances, brings components together on printed wiring boards, assembles and dip solders the components onto the boards, and finally tests the completed unit. Only four operators are needed to attend the machinery as it places 1600 components on 120 boards per hour.

General Electric began systems planning for the Automatic Component Assembly System in 1952. Such planning, along with evaluation of automatic programming, was carried out at the Advanced Electronics Center in Ithaca, New York. Some machine design and construction of the equipment took place at General Electric Plants in Schenectady. Cornell University's Thurston Hall Test Bay was the site of final integration and assembly as well as operational testing of the automated assembly line.



—General Electric Company

Drawing showing layout of ACAS equipment.

ACAS is especially suited to jobs involving two or more electronic subassemblies. The system accents flexibility as it reduces in-process inventory by handling job lot quantities and by allowing circuit changes to be programmed from one board to another. The system was contracted for development by the Signal Corps Supply Agency, for manufacture of radar and communication equipment subassemblies.

Beginning the chain of card programmed operations that produce a completed circuit assembly is the preparation of electrical components. Electrical components are introduced into the ACAS system by either being batch loaded if they are axial leaded, or manually loaded if they are multiple leaded into lead straightening dies. They are then loaded into component carriers to begin their travel through the system's testing and assembly facilities. Wire leads of the individual capacitors, resistors, etc., that make up the desired circuit are trimmed before being loaded into component carriers that hold each component throughout preparation and testing. To bring components into lead trimming position, the component carriers

are transported on 16 head indexing turrets.

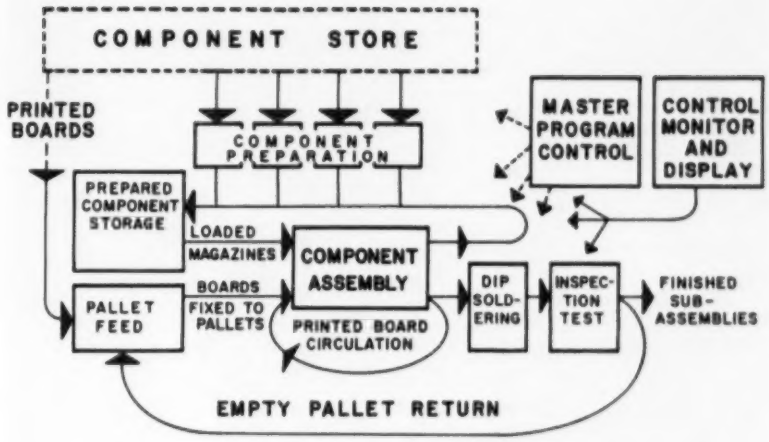
The indexing turrets, consisting of a revolving ring with stationary center and circumferential sections, bring components in carriers to various stations on their periphery. The synchronized operation is governed by cams that pick up tapered rollers to revolve the movable table speed of 1800 indices per hour with dwell time of 1.5 seconds.

Parts Pretested by Card Programming

The components enter the system at the lead preparation station, where axial, radial, or multiple leaded components have their leads trimmed and pointed for ease of insertion into printed wiring boards. Components are then indexed to the necessary number of the next ten stations where tests are carried out to determine if individual resistors, capacitors or tubes are within prescribed electrical tolerances. Tests are programmed for the components by punched cards. Card stored data is translated to signals from the card-reader to call out desired test instruments and voltages at the indexing heads. The testing circuits use the bridge principle, in which a standard is set up in the test circuit according to card programmed instructions, and the component functions as the unknown side of the bridge. Present equipment has enough extra test stations to permit he evenual incorporaion of transistor testing for subassemblies manufactured by ACAS.

After testing, parts are indexed through remaining stations to stations fifteen or sixteen. Satisfactory components are transferred to transport magazines at station ifteen for eventual positioning on printed circuit boards. Rejected components pass on to station sixteen, where they are expelled from the machine. Empty component carriers are indexed back through the loading perparation, and testing cycles.

Tested and approved components in acrriers are picked up by carrier transfer heads and loaded into transport magazines. The magazines are then transferred to a magazine elevator that retains prepared components until timing is correct for their travel to the placement head



AUTOMATIC COMPONENT ASSEMBLY SYSTEM

Block diagram of system functions.

for union with printed circuit boards. Two such elevators, one for each turret, enables proper component-to-board sequence to be maintained by providing for time differences in the presentation of varying types of components. If a component being prepared on one turret requires a longer time than does the component of the second turret, the hold elevator holds up the more rapidly processed component until the one with longer preparation time is ready to be assembled on a board.

Printed circuit boards require only loading into the ACAS before automation features take over to carry out manufacture of a subassembly. A conveyor carries the boards in a given batch to a storage elevator, from which boards may be called for component placement. A major feature of the Automatic Component Assembly is the component placement head tha brings an electrical component to its proper position on a printed circuit board. The head can move horizontally over the 12 inch dimension of an 8 by 12 inch standard wiring board. The head may also be rotated 157.5 degrees in 22.5 degree increments. Boards are positioned under the head with reference to their eight inch dimension at the beginning of the placement cycle for each batch of components. Card punched programming controls signals to servos that position the head angularly and with references to the boards' 12 inch dimension. Head loading sets up proper head position along the boards' 8 inch dimension.

Components in carriers are now driven down to the board, component leads inserted in the board, and the leads are gripped by an anchoring mechanism as the first step in actual assembly. Eempty component carriers then swing out of the way and are returned to the magazine for recycling to indexing turret. The gripping device holding the component leads nows pulls the lead wires through the boards and bends the ends over to provide mechanical fastening.

The mechanical precision of the ACAS enables the placement of components within 0.90 inches of each other, size permitting. Components up to 2.35 inches long by 2 inches high by .75 inches wide may be handled by the system. When a given component is placed on a board, remaining boards are cycled through the placement head until the entire batch has been processed.

Placement head operation in terms of the printed wiring boards reveals the function of programmed

—General Electric Company

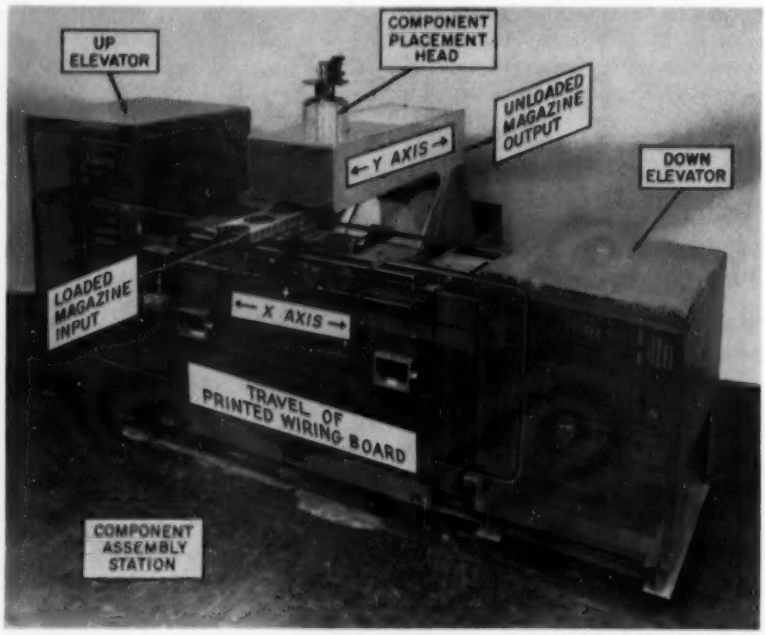
Indexing turrets automatically prepare electrical parts for assembly and test individual components.

commands to govern sequence of material motion and assembly processes. When the storage elevator for boards brings the first board to working position, taper pins are pushed into holes in the pallet frame holding the board to secure the board firmly for component positioning. An interlock now closes, allowing the head to place a component. When the head is sufficiently clear of the board, board motion is started by a signal that controls taper pin reaction and indexes processed the board away while moving a new board into position. After the entire batch of boards has been fed into the assembly station, the head takes over board position control as the equipment shifts from a "load" to "cycle" function. The head signals for boards in turn, placing a given component on all of them, repositioning for the next component, and again calling for the entire batch of boards for the next assembly cycle. When all boards have received all components, the head control calls for information regarding assembly of the next batch. Completed boards are ejected from the assembly station loop to the pre-solder storage elevator.

Dip soldering is the next step in sired physical specifications such facture. The boards, with all components mechanically attached, are passed over a flux spray of alcohol and rosin. They are next positioned above the solder pot, so that a ladle of molten solder may be brought up to the board. The board is rotated on the solder surface, solder adhering to the spray-fluxed areas of copper etched on the bottom of the printed wiring boards. Exacting control of solder viscosity is necessary to provide a strong joint between the component leads and fluxed copper surface. While they are in the solder bath, boards are pneumatically shaken to clean the soldered surface and to insure penetration into joints. After the board is moved away from the bath, it is again shaken to remove excess solder. After a short time period to allow solder solidification, the assembled board moves on to the pre test storage elevator to await final testing.

Final Testing Completes Process

Final testing is the last link in the chain of automatic functions. Pre-assembly testing of individual components and accurately controlled alignment have already been carried out to contribute to each assembly's reliability. The final test station therefore investigates each unit for component leads that have not entered their corresponding board holes, component leads that have not been soldered, and shorting out of printed board wires due to excess solder. To accomplish these tests, two classes of measurements are taken. First, a shorts test measures low impedance between one printed wire and the others to detect shorted conductors. Second, a continuity test measures low impedance from the lead of one component, through a solder joint,



—General Electric Company

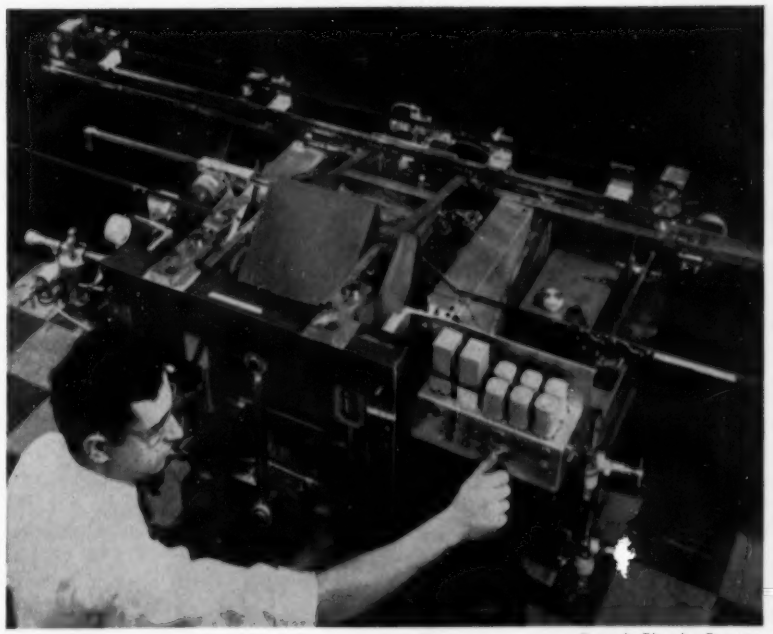
Placement level positions circuit elements on printed wiring boards.

along a printed wire to the lead of another component soldered to that wire. This test detects whether or not a lead has gone into its proper hole, and if it has been soldered. A paper tape printer records the types and number of tests failed by each board.

Master Program Control, consisting of card punching and card reading functions governs the overall sequence of assembly operations in the Automatic Component Assembly System. A stack of Remington Rand punched cards gives data completely specifying each electrical component along with its individual tolerances and pre-assembly tests, data on the number of printed wiring boards per batch, data on the order of component preparation, data on the location of each component on the printed wiring board and data on post assembly tests to be given to completed units. Cards for a given operation contain data for each station in the system. The data is called for when necessary to carry out the sequence of station functions. Inherent in the use of the Master Program Control is the ease of changing control functions by changing the punched card stack, as well as the ease of modifying an existing function by the insertion of new cards calling for new tests or components within a given program.

A monitoring control panel gives the supervising operator a complete picture of the status of assembly processes. The panel also provides a warning of malfunctioning equipment, and directly controls components to be loaded into the system by numerically displaying the number of components wanted and the type of components to be used.

The Automatic Component Assembly System project has utilized the skills of electronics and mechanical engineers, as well as systems engineers capable of coordinating both electrical and mechanical problems to evaluate overall system problems. Careful design was necessary to interrelate electricity and machinery in the movement and assembly of components, as well as to carry out a program of testing to extremely close tolerances.



—General Electric Company

Boards are dip soldered as soldering stations to secure components.

"Batch" Process Used

Indicative of systems engineering problems encountered in the design of the ACAS is the selection of the "batch" process of assembly over the in line method. In the batch process, printed wiring boards in a given group all receive a particular component from the placement head, and are then re-cycled as a group to receive the next component. This method is in contrast of positioning all components on one board before indexing the next board into assembly position. The batch process was selected on the basis of its flexibility and ease of placement head programming. The servomechanism positioning the placement head and boards can be adjusted for the entire group of boards in the batch process. For this reason, production rates can still be held at a high level while machine wear that would result from constant repositioning of the placement head is minimized. Inline systems would requre as many placement heads as components and lack flexibility. The batch size selected for the GE Automatic Component Assembly System is 20 boards. Larger batch sizes would require correspondingly larger facilities and a resulting cost increase.

The equipment has adequate facilities to store information, components and boards, carriers and pallets, and partially finished products, in order that it can call for and use them as necessary. Positions of assemblies and components within the system are sensed by micro switches located along the path of product flow. This sensing provides built in safety functions normally handled by human operators. Interlocks are arranged to prevent moving parts from damaging each other by operating out of sequence.

The General Electric Automatic Component Assembly System developed for the Signal Corps Supply Agency represents to date a 1.5 million dollar investment in automation for the electronics industry. Because of its large capacity for data storage, the system is capable of rapid production of electronic subassemblies with a minimum of machine setup and operator training time. This feature permits such systems to be ready for immediate operation to give stepped up electronics production if the need arises for industrial mobilization. In addition to its military role, the system's adaptability to job lot production, as well as its built in flexibility and ease of end-product modification, assure its significance as an important tool in the growing commercial electronics industry.

"Squeeze-Bottle" Plastic

by

DANIEL R. HUNTER, ChemE '58

Since the accidental discovery of celluloid by John Hyatt, and the preparation of the first synthetic plastic by Dr. Leo Baekeland, the engineers and scientists of the past half-century have been in the process of developing one of the most fruitful and useful groups of materials in history: plastics. Hyatt was determined to develop a plastic material when a New York newspaper offered a prize of ten thousand dollars to anyone who could find a substitute for the ivory used in billiard balls. He was employed as a typesetter and often had sore hands. One day while applying a solution known as *colloidin* to his hands, Hyatt accidently spilled some and noticed that instead of flowing along the table top the solution formed a thick skin. He experimented with the substance and together with his brother developed a cellulose nitrate plastic known as celluloid. The Hyatts organized a company in 1872 at Newark, New Jersey which soon expanded into the now famous Celanese Plastics Corporation.

However, cellulose nitrate was not the first synthetic plastic since it was also found in nature. The preparation of the first artificial plastic did not take place until some years later when Baekeland produced a resin which is now known as Bakelite. In applying for a patent on his new material, Baekeland stated that phenol and formaldehyde in combination with ammonia would produce a plastic material which could be molded into almost any desired shape. With the manufacture of Bakelite the modern plastics era was born. Today it is perhaps the fastest growing industry in the chemical field. Most homes of today contain an abundance of articles composed entirely or in part of plastics. Kitchenware, fishing equipment, automobile parts and countless other items contain in some part this latest product of man's ingenuity in providing cheap and versatile substitutes for older and more expensive materials. The unique properties of plastics are also responsible for many new things which other wise could never have been produced commercially.

In the largest classification generally used, plastics may be considered either thermoplastic or thermosetting. A thermosetting plastic is similar to Plaster of Paris in its formation. A chemical reaction takes place in the molding process and the substance "sets" as a rigid material. Once a thermosetting material has undergone a chemical change through the media of heat and pressure, it cannot be used again for the same operation. Thermoplastics, on the other hand, undergo a physical change only. When the heat is applied to the plastic in the mold, it softens, but throughout the operation its chemical composition remains the same. Also, unlike thermosetting plastics, after cooling it can be reheated and molded into another shape. Due to this thermoplastic characteristic which gives the material a greater versatility than the thermosetting type, this group of plastics has risen quickly in both volume and value of production in the past decade. Most of the earlier plastics were of the thermosetting type, but due to the impetus provided by World War II in the production of synthetics, the research and development of thermoplastic materials has almost eclipsed that of the older materials.

Polyethylene Is Versatile Polymer

In the past few months, the newest and what many experts believe to be the most versatile of all plastics yet developed, polyethylene, has ascended rapidly to a position of prominence in the chemical field. More and more everyday items are being manufactured from this very flexible and chemically inert material. As evidence of the rapid rise of polyethylene, a book copyrighted as recently as 1947

had this to say concerning the plastic: "Probably its greatest individual use is for high frequency cable. Because of its nature it is a specialized material and will not be used for notions and novelties." This was not one of the most accurate prophecies to make of a material which one engineer in the field of plastics predicts will be the first billion pound per year plastic in history.

Polyethylene is one of the simpler polymers in its chemical structure. The polymerization of ethylene takes place according to the formula

$$CH_2{=}CH_2 \longrightarrow -(CH_2{-}CH_2)_n-$$

This basic ethylene unit is repeated in a long chain structure with a molecular weight of 4000-10,000. The reaction, like most in industrial organic chemistry, requires carefully controlled conditions. Liquid ethylene obtained from natural gas or cracked hydrocarbons at a temperature from 335°-390° F and a pressure of 15,000-30,000 psi polymerizes to form the plastic. Both the temperature and the pressure can be varied over these ranges to give a material with a wide range of molecular weights. This property in the production of the material is another factor in evidence of the amazing versatility of the plastic. Polyethylene polymers with a molecular weight of 4000 are greases; polymers with a molecular weight between 4000 and 10,000 are hard, waxlike substances; when over 10,000 they are white, tough, leathery materials. In most plastics, including polyethylene, a plasticizer is often used to increase the characteristic of flow. However, the plasticizer in cases of thermoplastic materials also imparts some chemical and physical properties to the substance. These may be either desirable or harmful, depending on the type of molding operation necessary to manufacture the finished product. The percent plasticizer in a compound will depend to a great extent on the intricacy of design of the material to be molded. Unplasticized polyethylene possesses some excellent properties, but more commercial use requires both a plasticizer and coloring matter.

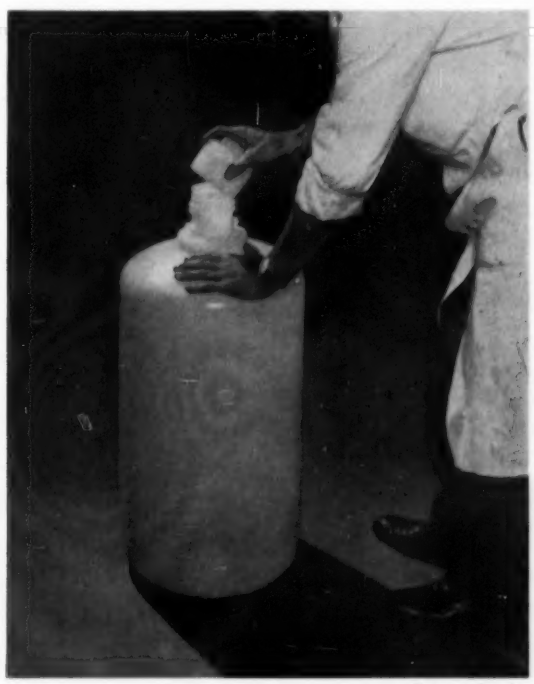
Crystalline Nature Determined

One of the mysteries which for many years baffled the top chemists in the world was the fact that polyethylene was not 100% crystalline, but seemed to contain a certain amount of amorphous plastic in equilibrium with the crystalline. This was true for most of the material manufactured for commercial use. After many months of concentrated research, it was discovered that the presence of two forms of polyethylene resulted from the fact that in each sample of the material there is a certain amount of unsaturation. Double bonds in the middle of the polymer chain tended to keep the chains apart. It was then found that double bonds at the end of the molecules did not materially interfere with close packing, thus giving a denser, more compact molecule than those whose unsaturation was in the interior of the molecule. Engineers immediately developed an improved method of manufacture and a material was produced in which most of the unsaturation is in the terminal bonds. The crystallinity of the plastic was then increased to a value of 90-95%. This was a very important advancement, since the strength and relative stiffness was found to increase with the percentage of crystalline material in the sample.

Polyethylene, like the teen-age boy who has grown too fast, has often been the object of misunderstanding. When it was first offered to the commercial market it was advertised as a wonder plastic, inert to almost every known reagent. This inertness led to one of its

—*Koppers Co. Inc.*

Polyethylene Ice Bucket



—*Koppers Co. Inc.*

Large Polyethylene Reagent Bottle

earliest uses, the bottling of concentrated hydroflouric acid. However, as usually occurs in our free enterprise system, the competitors of polyethylene began to deride these announced properties, claiming that polyethylene would crack violently in contact with methyl alcohol. It was reported that the plastic was unsatisfactory for cable usage, and that it was not suitable for packaging operations because of "suddenly developed" high permeability. The truth of the properties of polyethylene, of course, lies somewhere between the extreme pro of the manufacturers and con of the competitors.

Bottles Undergo Chemical Tests

Recently, an extensive survey was conducted by the Plax Corporation under contract by the U.S. Air Force, to determine the effect of chemicals on polyethylene packaging bottles. The eighty chemicals used in the study included some of the strongest acids, alkalies, and solvents. The chemicals were examined as to their effect on polyethylene bottles after one year of contact. They were tested at five temperatures ranging from 32°-165° F. This provided for 350 different chemical-temperature combinations. Of the various chemicals tested only 11, or 3%, showed evidence of such chemical attack on the plastic that its physical properties were deteriorated. Polyethylene sheets were also fastened to aluminum test cups to determine the effect of the chemicals in the equilibrium vapor phase. Various thicknesses were used to discover the possible variation of permeability with thickness of the bottles. Tensile and elongation properties, as well as susceptibility to stress corrosion cracking were measured on strips cut from the bottles after long-time storage conditioning. Any bottles which cracked during long-time storage had obviously been attacked. In addition, any bottle showing a tensile strength of less than 1500 psi and/or an elongation of less than 50% after long time storage was arbitrarily considered to have been attacked.

Of the materials tested, only concentrated nitric acid caused attack at room temperature, while only five other chemicals caused attack at the elevated temperatures. This chemical resistance data for polyethylene is important for contemplated applications of the plastic in chemical ware, chemical storage tanks, drum liners, piping, and other related products. "It is reassuring," say the manufacturers, "to know that, in general, polyethylene is not attacked on long time storage even by extremely corrosive chemicals."

Kriedl Process Allows Inking

This same very remarkable chemical inertness of the plastic was also, until recently, the cause for one of its most serious shortcomings: the difficulty to apply print and adhesives. This is a severe handicap to material which will undoubtedly be used extensively in the packaging industry. In most applications, inks and adhesives are held firmly by absorption to the porous surface of the carrier. In harder to print materials such as glass and cellophane, the effect is obtained by using glues made of polar resins and oils. The secondary valences on the surface of the glass are then directed toward the polar molecules of the glue and a firm bond is obtained. These ordinary methods, however, fail when an attempt is made to apply print to polyethylene. Since there are no appropriate solvents for the plastic at ordinary temperatures, no ink base can attack the surface. Also there are no appreciable polar forces on the surface, hence no secondary valences can be directed toward the ink base to establish a suitable bond.

In 1948 the problem was solved when the Kreidl process for better print adhesion was developed. This process utilizes physical rather than chemical means in the alteration of the polyethylene surface to make it suitable for ink bonding. The Kriedl process makes it possible to apply regular commercial inks to the plastic. The change is accomplished by heating the surface of the polyethylene with hot gas or an electrical element. The treatment is permanent, but the surface is not changed in appearance nor in its chemical or physical properties. The task of making the surface susceptible to ink particles is accomplished by oxidation, change in alignment of surface molecules, and a change in crystallinity. However, a comparison of infra-red spectra of treated and untreated polyethylene film shows that the affected surface is less than 1/100,000 inch in thickness. This accounts for the fact that

—Bakelite Company

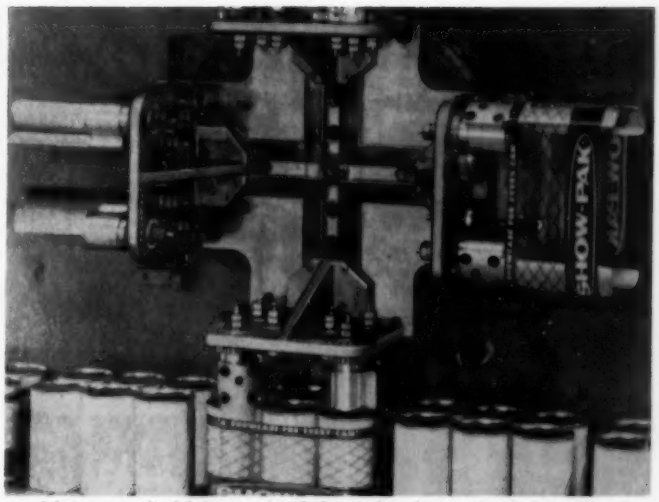
Pliable film bag withstands rough handling.

no measurable changes could be detected in the physical and chemical properties. The Kreidl Process has opened up vast possibilities for the utilization of polyethylene. Bottles can be printed, and decorated with decals or paper labels. Burets, pipets, and vials can be provided with calibration marks, opening new uses to chemists. Household utensils and novelties can be decorated by brushing or spraying. Finally, polyethylene is being used to coat paper or board containers, making possible many beautiful and special effects due to the gloss and smoothness of the plastic cases.

Polyethylene is also still being used to a great extent in the electrical industry where its high dielectric constant is advantageous. It can be found at present as insulation on cables, where its chemical inertness provides for a cable which will remain in service for a long period of time with a minimum of repairs necessary. Its flexibility is a great advantage in the construction of underground cable systems. The two properties of flexibility and chemical inertness also are coupled in the use of polyethylene pipe and tubing. Its inertness is so great that it often is used as a substitute for steel pipe in many areas where the chemicals in the soil would attack steel after only a relatively short time of continuous use. Here again, its flexibility is advantageous in the construction of pipe lines. A recent development is the use of cellular or foam type polyethylene for insulation material. This material is composed essentially of unconnected cells of the plastic with gas chambers interspersed throughout, and resembles a sponge in appearance. Here the resemblence ends, however, for the foam type plastic is much more rigid than sponge. It will not take the place of solid polyethylene in insulating materials, but will be used instead where its extremely low weight is advantageous.

"Low Pressure" Substance Developed

In the past few months, an almost entirely new product has been put into pilot plant production that may be sold commercially during the coming year. This is the so called "low pressure" polyethylene.

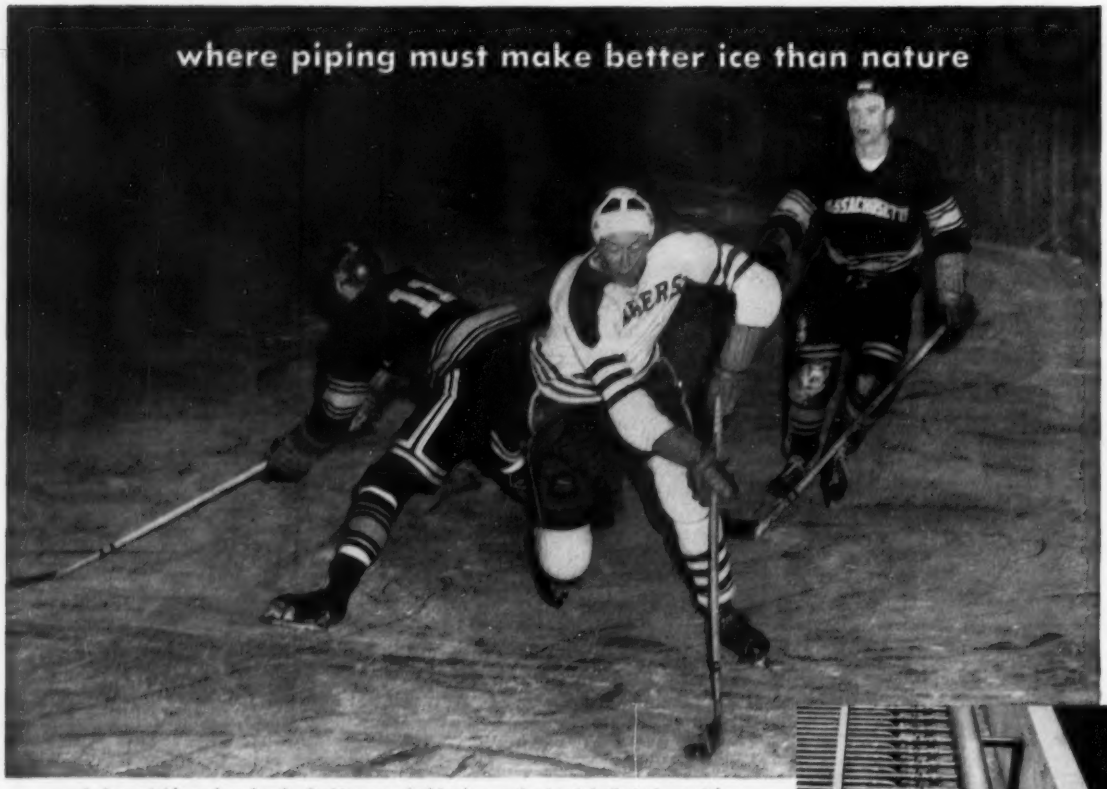


Six cans of beer or soft drinks are banded together in a polyethylene film in a pack that is easy to store, ship, display, or cool, by machine capable of handling 600 cans per minute.

A method has been discovered whereby the polymerization of ethylene takes place at pressures of less than 500 psi. This is far lower than the pressures previously required for the production of polyethylene. Although the actual process is patented and not known to many companies, the experts believe that the new process involves the use of metallic catalyst, possibly aluminum or chromium oxide in a solvent. This low pressure polyethylene has many properties which are superior to the high pressure type. It is extremely resistant to high temperatures, easily molded, shows a better gloss or finish than high pressure material, is substantially harder, and may be molded in larger pieces than is possible with ordinary polyethylene.

Washing machine agitators, steering wheels, battery cases, nursing bottles that can be boiled, and perhaps even returnable milk bottles, may someday be manufactured from "low pressure" polyethylene. The food processing industry is also interested. Soft drink bottles are a possibility. From polyethylene film, containers for pretzels and potato chips may be manufactured. Foods stored in polyethylene film may be sterilized after loading, without harmful effects on the food or the container. Despite these advantages of low pressure material, it does lose one characteristic of importance: flexibility. Therefore, engineers in the plastics industry are looking forward to producing a material which will be a mixture of high and low pressure polyethylene, retaining the desirable properties of both materials. However, like every other new product in the engineering field, progress continues to eclipse even the newest developments. Recently, experiments have been made in the field of plastics which have been bombarded by radioactive particles. Qualities and properties have been altered to such a degree that the resultant material is almost an entirely new product. Irradiated polyethylene will undoubtedly be put to use in industries where its properties are superior to previously developed plastics.

The time worn cliche, "What will they think of next?" may certainly be applied to the plastics industry and particularly to its most promising newcomer, polyethylene. Despite the advances and amazing new properties uncovered in the research on polyethylene, it is fairly safe to assume that new uses and a wide variety of entirely new products will spring from this amazing material. In a few years, the increased use of plastics may cause the ordinary water glass and other similar objects to take their place on the dusty shelve of museums along with the Stanley Steamer and the manual shift automobile. It is a safe guess that the increasingly useful "squeeze bottle" plastic will play a large part in converting many now familiar objects to the role of being quaint reminders of the "good old days."



A dependable surface for the flashing speed of hockey at the Jarvis-built Amherst rink

Rink builders rely on JENKINS VALVES

Modern skating rinks at sports arenas, colleges, schools, and clubs provide a hard, flawless surface on demand. Making better ice than nature requires critical valve control of hundreds of separate loops under the ice.

Arrested flow of the brine in even one loop could cause a dangerous "soft" channel across the surface. At any one of hundreds of critical points, faulty valve operation could easily shut down an entire rink.

Jarvis Engineering Co. of Boston, who built the Harvard, Amherst, St. Paul's, and many other fine rinks, have chosen Jenkins Valves for over 80 miles of piping involved. They know that the only true economy is to install the best valves that money can buy. Other rink specialists share their confidence in the demonstrated *extra measure* of efficiency and economy provided by Jenkins Valves, along with the leaders in every field of construction.

The Jenkins Diamond trade mark is their reliable guide to valve dependability, for all new installations, for all replacements. Jenkins Bros., 100 Park Ave., New York 17.

The JENKINS VALVES controlling each loop from the brine header in the St. Paul's School rink at Concord, N. H., are Fig. 1273 Bronze Gates with socket ends for silver brazing. These and other Jenkins Valves on lines to compressors, condensers, and pumps assure the critical control essential to efficient rink operation.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 THE JENKINS DIAMOND
Jenkins Bros.

The sign that will seldom go on in flight!

The four fierce horsemen that shake the skies—Thunder, Rain, Lightning and Hail—have met their match in Bendix* Airborne Radar. Planes equipped with this wonderful new device can now readily avoid turbulence and storms. Day or night, Bendix radar sees storms up to 150 miles ahead and projects a clear, detailed picture of their location, size and intensity on a scope in the cockpit so pilots can decide what to do—skirt the area or fly through it if the radar indicates a clear passageway.

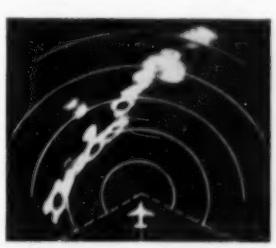
Young engineers who appreciate a challenge, at Bendix Radio Division in Baltimore—one of our many electronics divisions—made Bendix Airborne Radar a reality, as well as a thousand other products for just about every phase of modern industry.

Bendix is continually seeking additional young engineers, who combine talent and enthusiasm, to keep the list of Bendix "firsts" constantly growing. There's opportunity at Bendix—and the engineering graduate who joins this diverse, growing organization will quickly find it out.

*REG. U. S. PAT. OFF.

Bendix is in many businesses besides aviation and electronics. In fact, there's hardly an industry in which Bendix is *not* an important factor, from nucleonics to textile engineering. With 24 manufacturing divisions spread clear across the United States, Bendix combines the scope of a great corporation with the opportunity found only in individual autonomous divisions where ability is quickly recognized. You'll be wise to look to Bendix when you plan your engineering future.

See your placement director or send for the brochure "Bendix and Your Future" for a detailed look at Bendix activities. BENDIX AVIATION CORPORATION, FISHER BUILDING, DETROIT 2, MICHIGAN.



Actual storm ahead as pilot sees it on radar scope. It indicates that, by changing course very slightly to the right, he will find a smooth, storm-free route.

THE MARK OF Bendix AVIATION CORPORATION MILLIONS TRUST

Brain Teasers

Here are some problems to work on in your spare moments during rushing. We'll be waiting for the answers to pour in.

Here is a new puzzle to bend your brains:

A Dutchman with a goat and a goose met a milkmaid leading a cow. The maiden screamed in terror.

"What frightens you?" asked Hans.

"You are going to kiss me against my will," said the coy maid.

"How can I do that with these cranky animals on my hands?" asked Hans.

"What prevents you from thrusting your cane into the ground and fastening the goat to it and putting the goose under my pail?"

"Because that cross-looking cow might hook me," said Hans.

"Oh, that fool cow wouldn't hook anyone; and what is to prevent you from driving all three of them into my pasture field?" asked the terrified maiden.

During the subsequent conversation the following facts were discovered: They found that the goat and the goose together would eat just as much grass as the cow, so if that field would pasture the cow and the goat for 45 days, or the cow and the goose 60 days, or the goat and the goose 90 days, how long would it pasture the three together? Early replies are requested, as Hans and Katrina are contemplating a speedy partnership.

Can you help out our friends?

* * *

Hanging over a pulley there is a rope with a weight at one end; a monkey of equal weight at the other. The rope weighs 4 ounces per foot. The combined ages of the monkey and its mother are 4 years, and the weight of the monkey is as many pounds as its mother is years old. The mother is twice as old as the monkey was when the mother was half as old as the monkey will be when the monkey is 3 times as old as its mother was when she was 3 times as old as the monkey was. The weight of the rope and weight is half as much again as the difference between the weight of the weight and the weight of the weight plus the weight of the monkey. What is the length of the rope?

* * *

There was a young and adventurous fellow whose great-grandad left him nothing much but the logs from the old salt's seafaring days. The young fellow never quite got up courage enough to toss the books out, and one day was leafing idly through them. Stuck between two pages he found a much-folded paper which read as follows:

"Sail to 16 North latitude and 16 West longitude where thou wilt find a deserted island. There lieth a large meadow, not pent, on the north shore of the island where standeth a lonely oak and a lonely pine. There wilt thou also see an old gallows on which we once were wont to hang traitors. Start thou from the gallows and walk to the oak counting thy steps. At the oak thou must turn right by a right angle and take the same number of steps. Put here a spike in the ground. Now must thou return to the gallows and walk to the pine counting thy steps. At the pine thou must turn left by a right angle and see that thou takest the same number of steps, and put another spike into the ground. Dig halfway between the spikes; the treasure is there."

The instructions were quite clear and explicit, so our boy chartered a ship and sailed to the South Seas. He found the island, the field, the oak, the pine: indeed he found everything he was looking for but the gallows. Rain, sun, and wind had long since taken away all trace of the wooden structure. How did our hero find the treasure?

* * *

All I have left is this long gold chain," Smith announced sadly. "Will you let me pay for my room by giving you one link each day?"

"Yes," replied his landlady. "But it's a shame to cut every link in the chain."

"I'll cut very few as a matter of fact. After all, if there were only 7 links in the chain. I could give you a link a day for 7 days by cutting only one link."

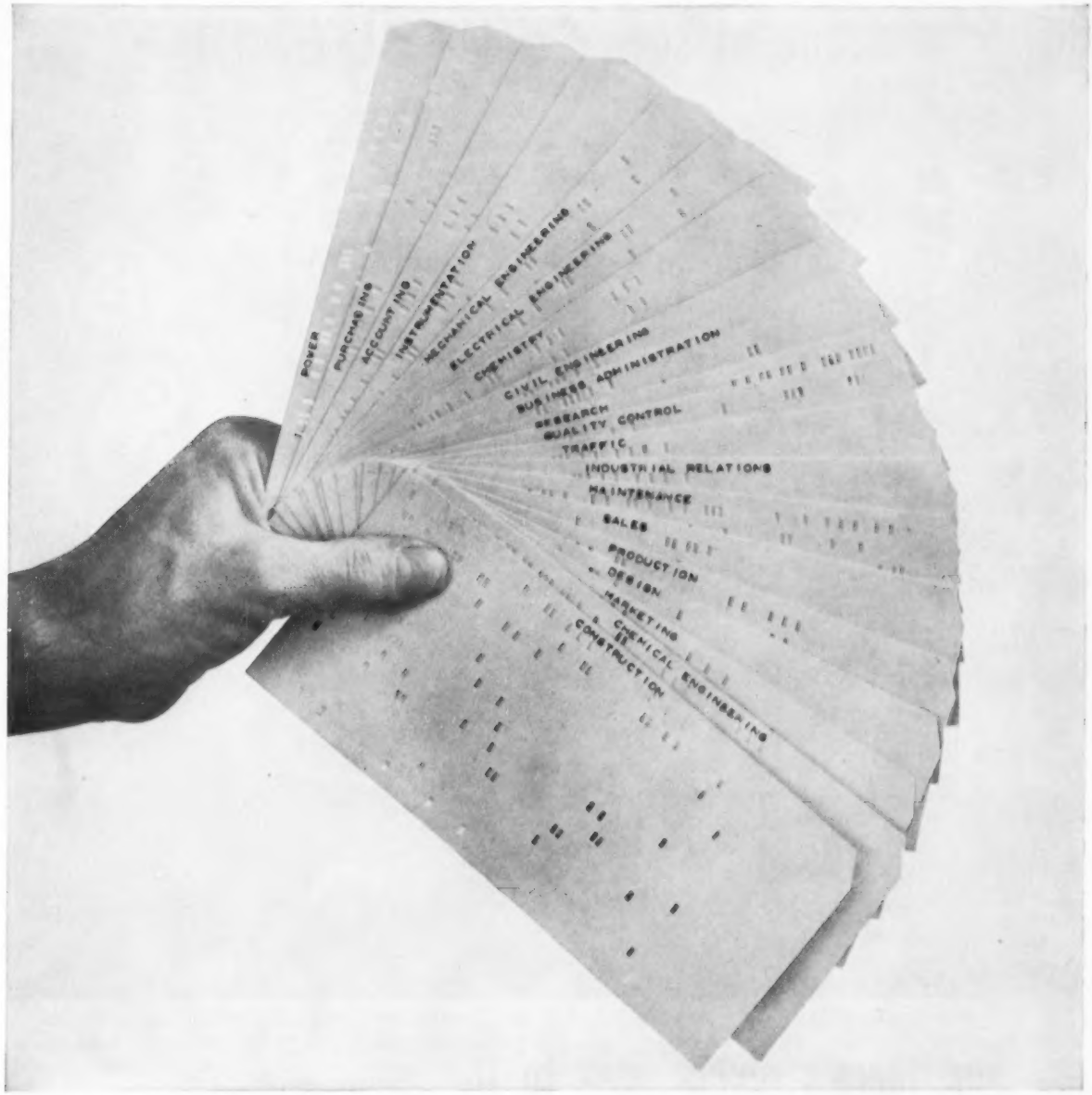
Mrs. Jones didn't understand how this could be done until her lodger explained it to her. Then they counted the links in Smith's long chain and decided where to cut to pay one link each day for 383 days with the smallest number of cut links.

We know that you would have no trouble working out the 7 link problem, but can you tell us where to cut the 383 link chain?

* * *

In each of the two differently furnished studios there are chairs and three-legged stools. If in each room all the legs had been stools, all the stools had been chairs, and all the chairs had been removed from the rooms, there would have been 100 too many legs in each room. How were the two rooms furnished?

Send your solutions to the CORNELL ENGINEER, *Lincoln Hall. The correct solutions to these and the January Brain Teasers will be printed next month.*



Which of these careers would you pick at Columbia-Southern?

If any of the fields above represent the one in which you want to make your career, then you should look into Columbia-Southern right away.

Columbia-Southern is one of the fastest-growing companies in the rapidly expanding chemical manufacturing industry. There are always excellent opportunities for capable young college graduates to become a vital part in the company's steady growth and expansion.

The principal activity of Columbia-Southern is chemical production—but the company also designs, builds and maintains its own plants and the equipment in them; owns and operates coal and limestone mines, brine wells, and a fleet of tank cars and barges; sells its products to every segment of industry in the United States and in other countries; and helps its customers put Columbia-Southern chemicals to work in producing many of the things essential to an ever-improving standard of living.

These varied activities require a corresponding variety of special skills. The opportunities are many. Columbia-Southern offers qualified graduates a liberal starting salary. A thorough "on-the-job" training program aids the new employee in learning more about his job and the company. Each employee's progress is reviewed periodically to insure that salary level keeps pace with demonstrated professional growth and increased responsibilities.

For further information on your opportunities at Columbia-Southern, write now to Dept. P at our Pittsburgh address or any of the plants.

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Thrust gage design is this Boeing engineer's "baby"

From layout to missile firing, this project is a Boeing engineer's responsibility. His assignment: to design an engine mount that will isolate from other loads and measure within ½ of 1% accuracy the tremendous in-flight thrust of a guided missile.

The mount, called a thrust gage, must fit engine and airframe without modification of them, and must "grow" equally in all directions during a temperature rise of several hundred degrees in less than a minute. The object is a stronger missile engine mount with less than half the weight of the present one.

This is typical of the challenging and creative assignments given Boeing engineers. There are more than 6,000 of them—mechanical, civil, electrical, aeronautical and nuclear engineers, and mathematicians and physicists. And more engineers of all kinds are needed.

This engineer is finishing his layout, with the preliminary mockup before him. Next, he will supervise draftsmen and engineering aides in final drawings. Then he will work closely with other engineers in production, structural testing, instrumentation and telemetering. Creating this thrust gage gives him responsibility, career growth, and a real sense of professional achievement.

Boeing engineers have career stability in a soundly growing company that now employs more than twice as many engineers than at the peak of World War II. Living is pleasant for them in the progressive, comfortable-size communities of Seattle and Wichita.

These men take satisfaction in knowing they're on a winning team that has created such aviation milestones as the new 707 jet tanker-transport, the giant B-52, and the Boeing B-47, "backbone" of Strategic Air Command. There's a rewarding job awaiting you now at Boeing in design, research or production.

For further Boeing career information consult your Placement Office or write to either:

JOHN C. SANDERS, Staff Engineer—Personnel
Boeing Airplane Company, Seattle 14, Wash.

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

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In all these ways, the RCA Government Service Department has proved its ability to give added strength to our Armed Forces.

WHERE TO, MR. ENGINEER?

RCA offers careers in research, development, design, and manufacturing for engineers with Bachelor or advanced degrees in E.E., M.E. or Physics. For full information, write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

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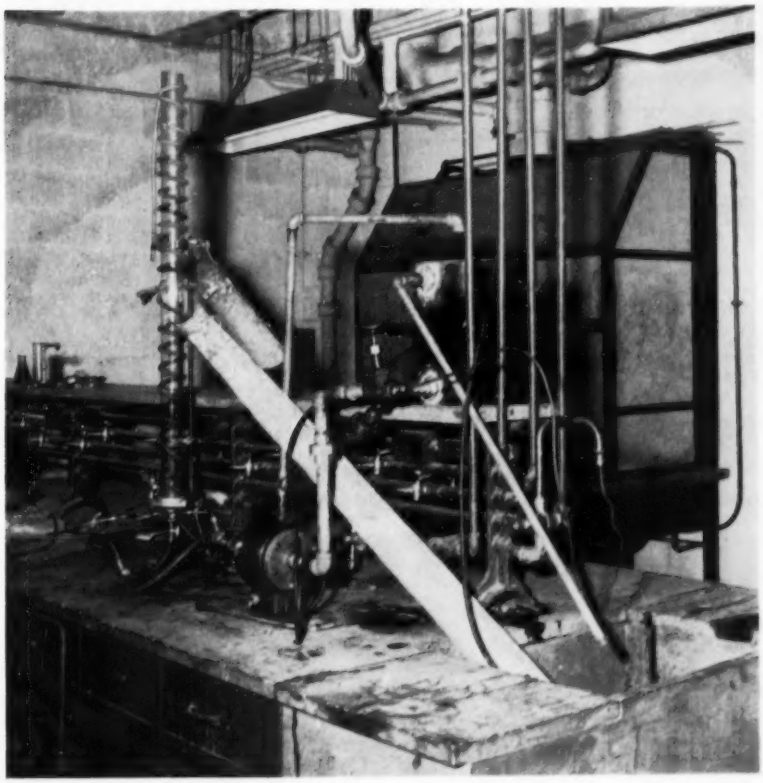
ELECTRONICS FOR LIVING

FIFTH - YEAR PROJECTS

Chem. E.'s Study Continuous Fractional Crystallization

Tom Davis and Jerry Sicherman are working under the supervision of Prof. Weigandt on a senior project in the Chemical Engineering School. The project is concerned with a method for continuous fractional crystallization. The system with which they are working is a mixture of ortho dichlorobenzene and para dichlorobenzene.

The separation of the para dichlorobenzene from the ortho isomer by the ordinary methods of distillation or by chemical methods is difficult because of the similar boiling points and chemical properties of the compounds. The freezing points of the two chemicals are considerably different, however, which makes them separable by fractional crystallization. The para isomer crystallizes at 53°C while the ortho isomer solidifies at -17°C. When a molten mixture of the two isomers is cooled, the para dichlorobenzene crystallizes first and settles out. Each crystal of para isomer is surrounded by a thin film of ortho isomer, which clings very tenaciously because of its similar chemical and physical properties. The major problem in the purification of the para dichlorobenzene lies in the removal of this film of ortho dichlorobenzene since the solid crystal is pure para dichlorobenzene. A logical way of accomplishing this is to rinse off the layer with pure, molten para isomer. The methods presently used in industry are expensive and time consuming. A simpler, cheaper, faster method is much desired.



This problem was worked on and partially solved at Cornell last year by Landon Nichols for his Ph. D. thesis. Nichols passed cold brine and the molten dichlorobenzenes into the center of a vertical one inch column. The crystals settled to the bottom of the column where they were heated and melted. The hot, molten para dichlorobenzene rose up through the column because of its lower density and washed the newer crystals coming down. Some of the molten para was removed from the bottom of the column as product and the remainder was allowed to pass up through the column as reflux. When this method was tried in a larger column in which the wall effects were less pronounced, the up-flowing para was so turbulent that the para crystals formed could not settle to the bottom. In the next process Nichols tried, he pumped cold water and the mixture of dichlorobenzenes through separate lines into the bottom of a six-inch column. The para dichlorobenzene crystals formed a bed which was forced up the column by the hydraulic pressure of the liquid coming in. The crystal bed was packed tightly enough to allow the liquid water and ortho-dichlorobenzene

(Continued on page 31)

NEW PRODUCT in the air conditioning field is Worthington's ultra-modern winter and summer home air conditioner. It's a compact package that heats, cools, circulates, filters, and controls humidity. Like every Worthington product, this good-looking unit is designed and built for a lifetime of quiet, efficient service.

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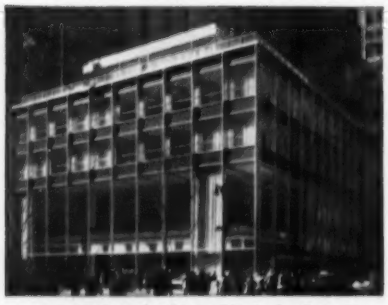

NEW BUILDING in New York is the glass-sheathed Manufacturer's Trust Building. It's cooled by a Worthington central station system—so big it does the same job as melting 300 tons of ice daily.

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For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Mgr., Personnel & Training, Worthington Corporation, Harrison, New Jersey. 4.25D

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Fifth Year Project (continued)

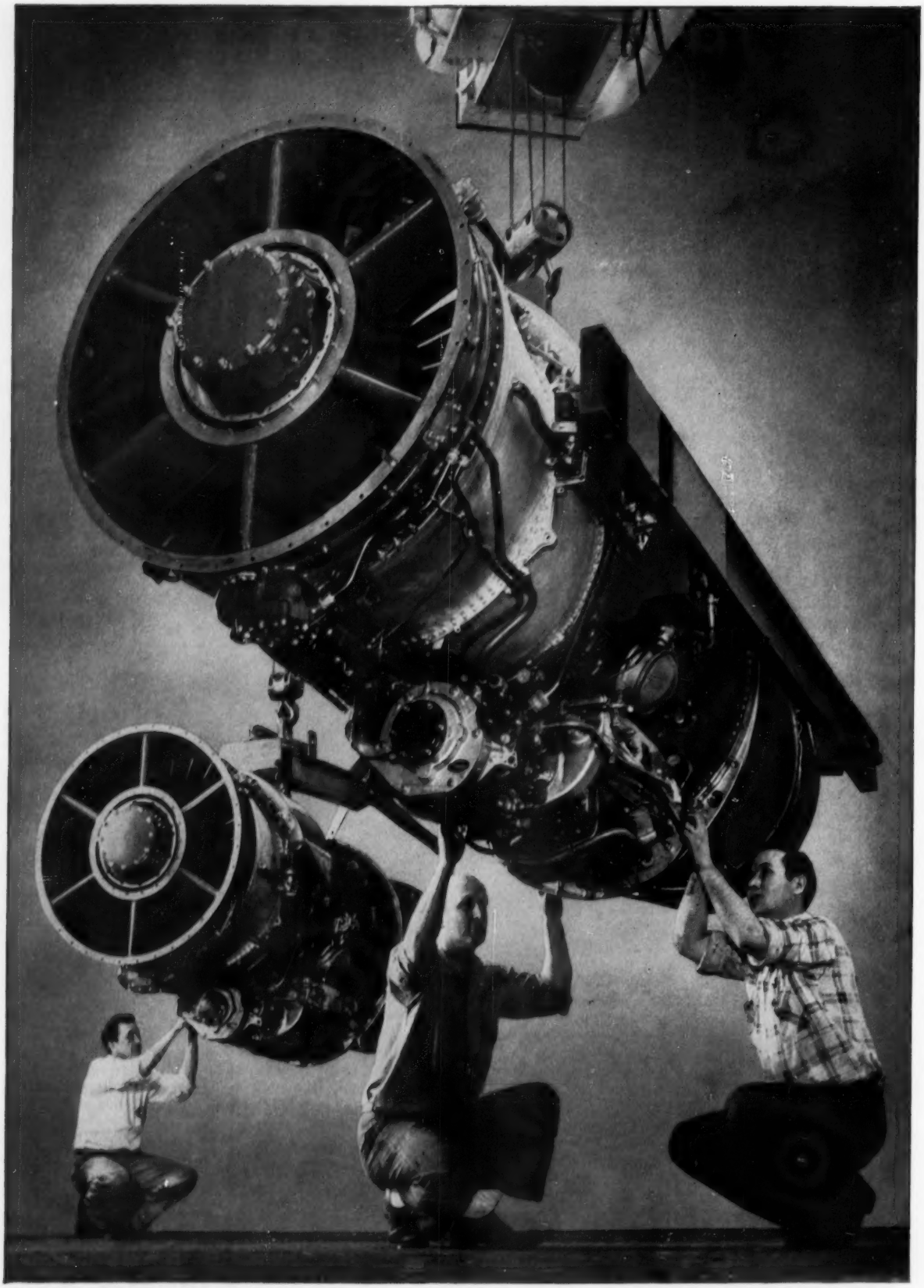
to be drawn off through openings in the side of the column. The core of crystals were forced up through the column and removed at the top. Attempts to work the crystals with molten para-dichlorobenzene as they came up through the column were unsuccessful. The molten para passed through the bed in small channels and flowed into the water outlet lines where it crystallized and plugged the appartus.

Tom and Jerry are working on the problem of finding a successful method for the continuous countercurrent washing of the para-dichlorozenzene crystals with molten para-dichlorobenzene. They first attempted to form a very porous bed of crystals which would permit better countercurrent washing. Cold air was bubbled through the mixture of dichlorobenzenes in hope that crystals would form around the surface of the bubble and be carried to the top of the column where they could be washed with a molten para-dichlorobenzene. It was found that the cold air was unable to cool the liquid enough to form crystals.

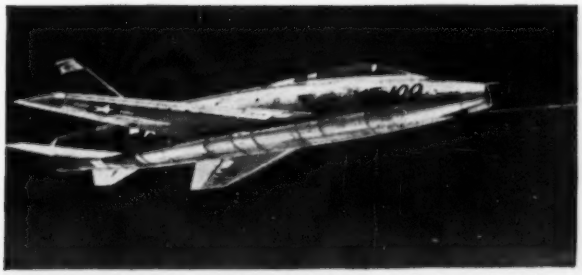
They then tried a vaporizing liquid as the cooling medium. The pressure in the column was reduced, and water was admitted to a continuous phase of dichlorobenzenes. Heat was removed from the system by the vaporizing water and crystals were formed, but they did not adhere to the rising bubbles. The idea of a porous, floating bed was abandoned.

Since this method was unsuccessful, Jerry and Tom have devised a new scheme. Cold brine having a density greater than that of the dichlorobenzenes is to be used as the coolant. The cold brine and dichlorobenzene mixture will be pumped into the bottom of a two-inch column, where the crystals will be formed and compacted into a bed which will be forced up the column by the pressure of the incoming liquids as in Nichol's apparatus. Approximately half-way up the four foot column the brine and ortho dichlorobenzene will be drawn off. Flow rates will be adjusted such tha a molten layer of para may exist just above the brine outlet. The rising core of para crystals with their thin films of the ortho isomer will be washed as they pass through the layer of molten para dichlorobenzene. At the top of the column, the nearly pure para crystals will be collected and melted. Part of it will be withdrawn as product and the remainder will be returned to form the layer used to wash the rising crystals. Tom and Jerry are presently busy overcoming difficulties with their equipment. Among their problems are solidification of the para dichlorobenzene in pumps and lines, the plugging of inlet nozzles and outlet lines, and corroded tanks.

If Jerry and Tom are successful in perfecting this method of continuous crystalization, there will still be more work to do on it. It will then be tried on larger scale bases until it is proven either practical or impractical for industrial usage.

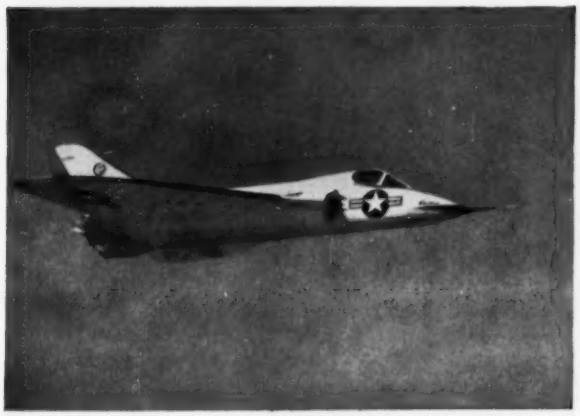


The J-57, in the 10,000-pound thrust class, is the most powerful turbojet engine now in production. A new generation of U.S. air power has been designed around this mighty new Pratt & Whitney Aircraft engine.



North American's F-100 Super Sabre, fastest Air Force jet fighter, is powered by Pratt & Whitney Aircraft's J-57 engine.

First all-jet heavy U. S. Air Force bombers are the huge Boeing B-52s, powered by eight J-57s mounted in pairs.



The Douglas F4D Skyray, fastest Navy jet fighter, will be powered with the big J-57 engine.

The Douglas A3D, the Navy's most powerful carrier-based attack airplane, has two J-57 engines.

Blazing the Way for a New Generation of Air Power

The most powerful turbojet engine in production is blazing the way for a whole new generation of American aircraft.

That engine is Pratt & Whitney Aircraft's J-57, the first turbojet to achieve an official rating in the 10,000-pound thrust class.

But the J-57 provides far more than extreme high thrust. Its unique Pratt & Whitney Aircraft design, achieved after years of intensive research and engineering, offers as well the low specific fuel consumption so vital to jet-powered bombers and future transports, plus the additional important factor of fast acceleration.

The importance of the J-57 in America's air power program is clearly shown by the fact that it is the power plant for three of the new "century series" fighters for the U. S. Air Force—North American's F-100, McDonnell's F-101 and Convair's F-102—as well as Boeing's B-52 heavy bomber. The Navy, too, has chosen the J-57 for its most powerful attack aircraft, the Douglas A3D, the Douglas F4D fighter and for the Chance Vought F8U day fighter. And the J-57 will power the Boeing 707 jet transport.

The J-57 is fully justifying the long years and intensive effort required for its development, providing pace-setting performance for a new generation of American aircraft.

Engineering graduates who can see the challenge in this new generation, might well consider a career with the world's foremost designer and builder of aircraft engines.

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DIVISION OF UNITED AIRCRAFT CORPORATION
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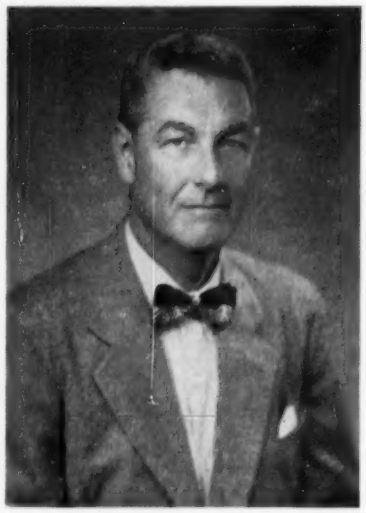
CORNELL SOCIETY OF ENGINEERS



William M. Leonard

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates, and former students and to establish closer relationship between the college and the alumni."

ALUMNI PLACEMENT COMMITTEE

It is wonderful to be President—you get so many interesting invitations. The other day I was asked to meet with a small group of loyal citizens, known as the Cornell Alumni Placement Committee. We met at the Barclay in New York to compare notes over lunch.

When we got down to business, I was pleased to see that the Engineers whom I represented were as well organized to handle alumni placement as any group—with the possible exception of the hotel management people for whom Vic Grohmann does an outstanding job.

Our happy situation did not just happen. We engineers have been working on the placing of engineers in industry for a longer time than you fellows have been on earth.

All of us are indebted to those who have gone before for what they have done to make our road today smoother and easier. It is, therefore, eminently appropriate to give recognition here to the voluntary and unselfish work done by the Cornell engineers who started and carried on the placement work for Cornell engineers.

The first one that I know of was Clyde Potts '01 who started in 1908 as a representative of the Cornell Society of Civil Engineers in placing civil engineers. Later, about 1920, when the three colleges were merged under one head, C. S. Rindsfoos '06, representing the new Cornell Society of Engineers, undertook placement work for all Cornell engineers.

In 1922 Carroll R. Harding C.E. '10, took over this work and carried it on for two years. He was followed in succession by C. M. Chuckrow '11, who did the job until 1928, then H. E. Irish '16, carried it on until 1932, when the Cornell Club Employment Service was established. This came into being as the result of efforts of Jansen Noyes '10, who was at that time President of the Cornell Club of New York. As a result of the success of this work in New York and soon after starting the Cornell Club Employment Service, the University itself established a Placement Bureau in Ithaca to handle placement work for all Cornellians. This was put under the direction of Herb Williams '25.

About 1946 John L. Munchauer '40 was made director of the Cornell University Placement Office and it is still under his direction. In the meantime, starting about 1932, Paul O. Reyneau, M.E. '13, was made Director of the Cornell Club Employment Service and continued in charge of this office after it was made the New York office of the University's Placement Bureau around 1944, and served most effectively until his death in 1952.

Miss Maria Nokos, Paul's secretary, carried on in the New York office until her resignation in 1954. For a few months John Munchauer ran the New York Placement office from Ithaca until George Mueden's appointment in 1955.

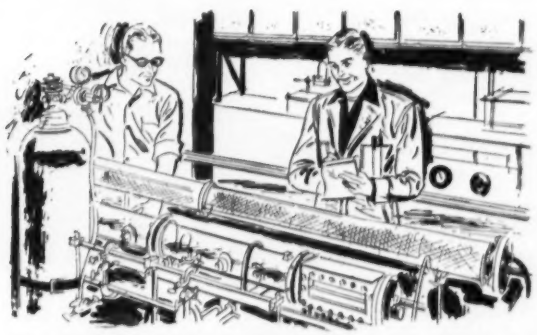
Among Alumni activities none would seem to be of more real value to the individual over the long pull than the Cornell University Placement offices. The Ithaca office in Day Hall, under the direction of John L. Munchauer '40 and the New York office in the Cornell Club of New York at 107 East 48th Street, under the direction of George Mueden, C.E. '40, are ready to assist all Cornell engineers who would like to take advantage of their facilities, be they employers or men looking for work or changes of association. The New York office confines its work to the New York Metropolitan area. All correspondence and all inquiries outside this area should go to the Ithaca office. The two offices cooperate in exchanging openings and applicants. I highly recommend and urge Cornell men to use the services of these two Placement offices.

—William M. Leonard, *President*

College graduates getting ahead...
growing with UNION CARBIDE

"I'm a chemical engineer, Class of '52, and a Technical Representative for Carbide and Carbon Chemicals Company. I work through one of Carbide's 23 Sales Offices, calling on all the process industries in my area. My job is to open up markets for new products and find new uses for old products. I try to be a valued technical consultant to my customers."

"I'm a metallurgical engineer, Class of '51. I wanted to get into development work, so I started with Electro Metallurgical Company in their Metals Research Laboratories in Niagara Falls. Three years' research work in steels and titanium gave me the technical background I needed. Now I'm working on applications of titanium as a development engineer."



"I'm a mechanical engineer, Class of '49. I started in the Tonawanda, N. Y., laboratories of Linde Air Products Company. In a few months I was doing research in low-temperature rectification and heat transfer equipment. Now I'm a Section Engineer, responsible for a group of research and development engineers—a member of LINDE's management team."

"I'm a chemical engineer, Class of '50. I started with Bakelite Company, in their training program for production. Now I'm Assistant Department Head at the main plant in Bound Brook, N. J. The group I direct handles resin quality control and technical service. BAKELITE gave me the chance to rise to a significant position in management."

THEY ARE KEY MEN WITH A FUTURE If you are interested in a future in production, development, research, engineering, technical sales, or advertising and public relations, check the opportunities with any Division of Union Carbide. Get in touch with your college placement officer, or write directly to:

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UCC

Industrial Relations Department, Room 406
30 East 42nd Street, New York 17, N. Y.

ALUMNI ENGINEERS

W. Nicholas Kruse, B.Chem.E. '42, '43, 417 South Lincoln, Hinsdale, Ill., is with the engineering sales department of Procon, Inc., Des Plaines, Ill.

B. Otto Roessler, C. E. '31 is public works officer and officer in charge of construction at the Naval Air Station at Pensacola, Fla. He reports that he has been selected for promotion to captain in the Civil Engineer Corps of the US Navy. His daughter, Kay, entered Mary Washington College this fall and his son, Dick, is in the second year of Pensacola High School.

Jackson Hazlewood, M.E. '32, MME '33—After thirteen years with Fuller & Smith & Ross Inc. of Cleveland, Ohio, resigned last September to become vice-president of Keeling & Co., Indianapolis, Ind. advertising agency. His new address in Indianapolis is 1040 Collingwood Drive.

Calvin O. English M.E. '41, BS in AE has been appointed head of the phenola molding material and resin pulverizing departments at the Bound Brook (N. J.) plant of Bakelite Co., a division of Union Carbide & Carbon Corp. Since joining the company in 1945, English has been engaged in quality control and production activities in operations. He and Mrs. English have three daughters and one son.

Calvin O. English '41

Address: 5 Tuxedo Place, Cranford, N. J.

Guy T. Morris, M.E. '12 retired in 1954 as a patent attorney with Bell Telephone Laboratories and now lives at 3232 Ft. Myers, Fla.

George A. Worn, M.E. '17, '18 is West Coast representative of the heat exchanger division of The Lummus Co. He moved last December from Greenwich, Conn., to 6706 Avenida de la Manana, La Jolla, Cal.

John P. Riley, C.E. '22, for many years the director of development for the New York City Housing Authority, January 1, 1956, became vice-president and chief engineer of IBEC Housing Corp., New York City, which uses a mechanical, pouredin-place concrete building method and is currently constructing 1625 houses at San Juan, Puerto Rico. Since 1939, Jack has supervised the development of more than a billion dollars worth of housing for the Housing Authority and also served as coordinator of school construction for the Board of Education of New York City.

William C. Spiker, C.E. '00, Box 11, Mountain View, Ga., is a semi-retired structural engineer, specializing in recommending unit loads and types of foundations. He is a widower and has three sons.

Stanley G. (Stan) Palmer, M.E. '10, is still dean of the college of engineering at University of Nevada and makes his home at 533 University Terrace, Reno, Nevada. A year ago, Stan served as president of the National Council of State Boards of Engineering Examiners. He is, at the present time, a member and secretary of the Nevada State Board of Registered Professional Engineers.

Wilmer A. Dehuff, C.E. '10, for many years principal of Baltimore Polytechnic Institute, last June received the honorary degree of Doctor of Humane Letters (LHD) at Lehigh University.

Lewis B. Swift, M.E. '12, chairman of the board of Taylor Instrument Co., Rochester, reports that he was awarded the degree of ""Fellow" by the American Society of Mechanical Engineers last March. He lives at 2829 East Avenue, Rochester 10.

Stephen M. Jenks, M.E. '23, assistant executive vice-president-operations, United States Steel Corp., has been named winner of the Benjamin F. Fairless Award for distinguished achievement in iron and steel production and ferrous metallurgy. The award, which is given annually by the American Institute of Mining & Metallurgical Engineers, will be presented to Jenks next month at the annual meeting of the Institute in New York City.

Stephen M. Jenks '23

Franklin H. Bivans, B.Chem. '27, '28, 140 North Broadway, White Plains, has been appointed production manager of Schieffelin & Co., New York City. He was formerly with Bristol-Myers Co.

Richard L. Best, B.E.E. '43, '44, Box 329, Wayland Mass, is with Lincoln Lab, Massachusetts Institute of Technology, Lexington, Mass.

Windsor D. Lewis, E.E. '27—After eleven years in England and France as director of operations for Westinghouse Electric International Co. in the United Kingdom and Europe, he has returned to the company's headquarters at 40 Wall Street, New York City, where he is director of sales in the United States for export.

PPG's expansion program is creating new opportunities

Since the beginning of Pittsburgh Plate Glass Company 73 years ago, it has constantly reflected solid growth and expansion. In the past ten years alone, almost $300 millions have been spent in plant expansion to increase essentially the production facilities.

During this same period, PPG's personnel has increased 86%! The nature and diversity of PPG's products assure continued future growth in its many markets.

PPG believes in filling the many new positions of responsibility from within its organization. It needs men of promise to carry on its impressive record of growth and expansion in its various divisions: Paints, Glass, Chemicals, Brushes, Plastics, Fiber Glass.

If you would like to become a part of the dynamic PPG organization, write today for more information. Just address Pittsburgh Plate Glass Company, General Personnel Director, One Gateway Center, Pittsburgh 22, Pennsylvania.

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PITTSBURGH PLATE GLASS COMPANY

345 PLANTS, MERCHANDISING BRANCHES, AND SALES OFFICES LOCATED IN 250 CITIES

Dave McGinnis asks:

Does Du Pont Have Summer Jobs for College Students?

C. David McGinnis will receive his B.S. degree in mechanical engineering from the University of Texas in June 1957. Currently, he's senior manager of men's intramural sports and a member of the Delta Upsilon and Phi Eta Sigma fraternities at Texas.

Ivar A. Lundgaard obtained two degrees, B.S. in Ch.E. and A.B. in economics, from the University of Rochester, and joined Du Pont's Photo Products plant at Parlin, N. J., in 1942. Later that year he became a shift supervisor and was promoted steadily thereafter. By 1951 he was Production Superintendent at Du Pont's Rochester plant. Today Ivar is Polyester Department Superintendent at Parlin, well able to speak about Du Pont employment policies out of his own experience and observation.

Ivar Lundgaard answers:

Yes, Dave, the Du Pont Company regularly employs students of science and engineering in its *Summer Technical Training Program.* The chief purpose is to provide good technical training under industrial conditions. And we learn about the students while they learn about us.

Students selected for the program after campus interviews include candidates for the B.S., M.S., and Ph.D. degrees. Assignments are related to their academic interests. Last summer 270 students from 93 institutions participated in the program. In this way, ties are often established which can lead to permanent employment after graduation.

In addition, many other students are hired directly by individual Company units to help out during vacation periods of our regular employees. For this "vacation relief work," assignments are likely to be varied; but these students also gain valuable insights into industrial practice, and many acquire experience related to their fields of study.

Altogether, about 750 college students, from both technical and nontechnical fields and at all levels of training, obtained experience with us during the summer of 1955. So you can readily see, Dave, that the Du Pont Company attaches a lot of importance to summer jobs for college students.

Prominent Engineers

John Baldeschweiler

In the field of engineering activities, John Baldeschweiler is outstanding at Cornell. Probably the most time consuming of his activities is his position as President of the Cornell Engineering Council. Under John's leadership, the Council is planning a study of the possibility of an honor system in the College of Engineering, and a calendar of various engineering functions. The Council is also sponsoring a freshman tutoring program in conjunction with Tau Beta Pi and various other functions which the Council has sponsored before.

John's experience as secretary of the Council will be a great aid in carrying out this program.

Last year John was chairman of Engineer's Day when both an afternoon and evening program were innovated. At last year's Engineer's Day emphasis was placed on attracting high school students to the exhibits. The program carried out was quite successful in attracting these students.

John, a fifth year Chemical Engineer from Cranford, N. J., is a member of Lambda Chi Alpha fraternity. He is also a member of Pros-Ops, honorary Chemical Engineering fraternity, and vice president of Tau Beta Pi, honorary engineering fraternity. From his freshman year through his senior year John was a member of the Glee Club.

Last summer, John held a job in one of the nuclear laboratories at Los Alamos. Most of John's work with the nuclear reactors was of a classified nature in design and research. This work was especially interesting to John since he has taken courses in nuclear physics. Previously, John had worked at E. I. DuPont and Standard Oil of N. J. as a research assistant.

John is now doing a senior project in separation of hydrocarbon mixtures by thermal diffusion.

After graduation John plans to study either physical chemistry or chemical engineering on the graduate level and work toward a Ph.D. Eventually, John would like to get into the field of industrial research but this time is so far off that he has no definite plans along this line.

Jim Larrimore

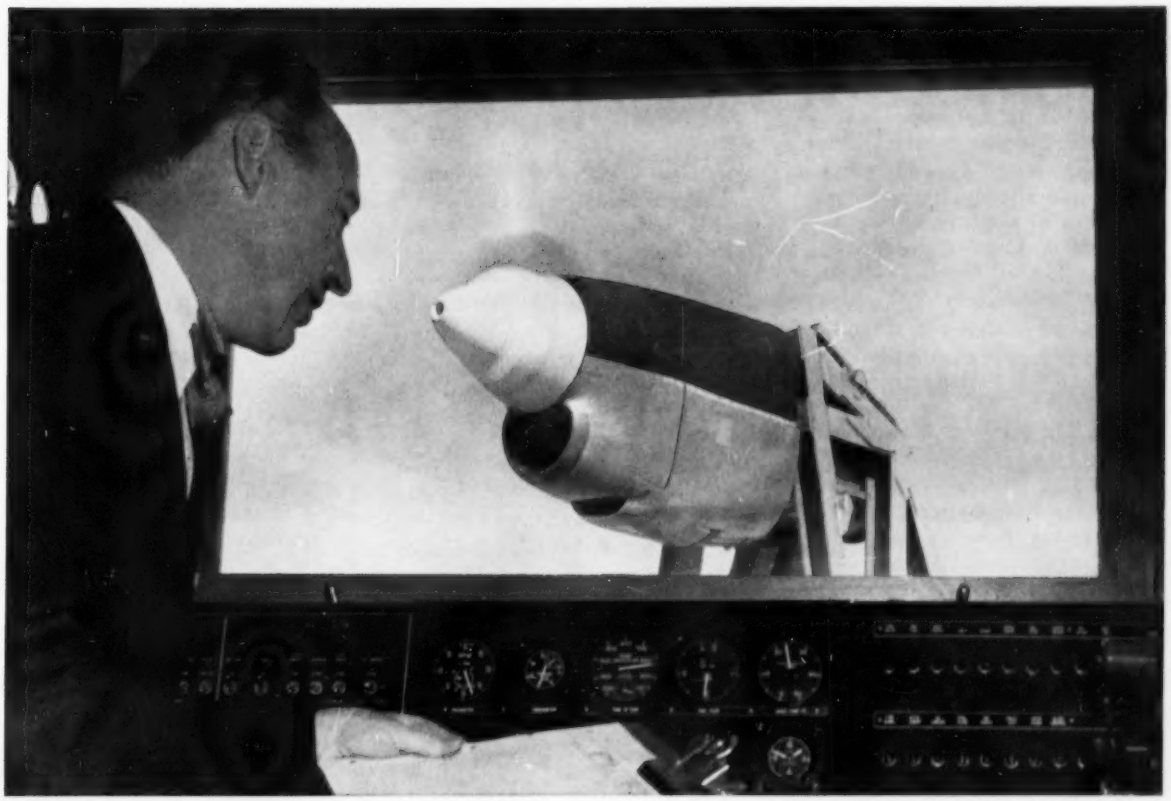
The graduates of Cornell engineering are highly regarded in industry only partly because of their technical competence; the other part is that they are generally well-rounded. Their student days have included a well balanced mixture of technical studies, social life, and extra-curricular activities. It is to the credit of the Engineering Schools at Cornell that the students who show the most interest in and aptitude for their engineering studies are frequently some of the most versatile and active on campus.

Jim Larrimore, a fourth year student in the school of Engineering Physics, is a fine example of a Cornellian who has been quite successful both in and out of classes.

The facts that Jim is third in his E.P. class, and is a member of Tau

(Continued on page 42)

16 TIMES "AROUND THE WORLD" AND NEVER OFF THE GROUND!



WHAT KIND of double talk is that—"16 Times Around the World, and Never Off the Ground?"

It's like this. With Allison's entry into the commercial airline field, there is a need for flight data on turbo-prop engines before they are put into regularly scheduled commercial service. In the absence of actual data, Allison is running a 1000-hour test schedule with a Model 501 turbo-prop engine mounted on an outdoor test rig.

In reality, 1000 hours of flying time represents about 16 times around the earth, is the equivalent of about 4 months of normal, commercial airline usage.

For this test, actual airline operating schedules are used. This means that the engine is run through complete cycles of starting, ground idle, take-off, climb, cruise and descent for landing, and the cycle is repeated continuously 'round the clock as the schedule simulates trips of from 250 to 2500 mile blocks.

One of the young engineers who has been working on the project from the start is Donal J. Nolan, shown above at the test instrument control panel. Don is assistant chief, installation engineering at Allison. After his graduation in '42 from Case Institute of Technology, he came to General Motors in 1943 with a degree in ME.

Commercial acceptance of the Allison turbo-prop engine started with the purchase of a quantity of Allison-powered Lockheed Electras by American Airlines. This initial purchase, plus plans of other leading airlines to adopt the Electra, opens a new chapter in the growth and development of Allison Division of General Motors Corporation. Already a leader in the design, development and production of turbo-jet and turbo-prop engines for military use, Allison is underway with a long-term engineering expansion program covering advanced military and commercial engine installations. This $75,000,000 program, providing for newest engineering and research facilities, intensifies the *immediate* need for engineers.

Opportunity for young graduate engineers is unlimited at Allison. Arrange now for an early interview with our representatives on your campus, or write now for information about the possibilities of YOUR engineering career at Allison: R. G. GREENWOOD, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

ALLISON
TURBO-PROP ENGINES
American built for the new era in air travel

Beta Pi, merely reflect the more important fact that he is motivated by a genuine interest in engineering and science. This interest seems to be backed up by ability.

But what about the non-scholastic side of Jim's life at Cornell? His principle efforts and successes have been in the fields of singing and politics; he isn't sure what the connection between them might be. Beginning with Orpheus as a freshman, and continuing with the Glee Club, he has been singing during each of his three and a half years at Cornell. Furthermore, he is now a member of Cayuga's Waiters, an outsanding entertainment group which has sung all over the United States. Belonging to both the Glee Club and the Waiters takes a great deal of Jim's time, but he considers it time well spent.

Jim's greatest distinction in the vocal realm, however, has come from the glee club of his fraternity. This group, under his direction for the past three years, has won two first places and one second place in the annual competition.

Jim once jokingly remarked of his high school activities that he had been a "politician". His instinct for politics must linger on, for he has been vice president and is now president of his fraternity, Phi Delta Theta.

A job such as house president involves working with people, at which Jim is very good. The first impressions that one gets upon meeting him are of his friendliness, sincere and plentiful but never forced, and his pleasant good humor. It doesn't surprise anyone to learn, after meeting him, that he is quite socially inclined. Some of his friends suspect that he is the incorrigible bachelor type, but as yet there is little evidence to support this belief.

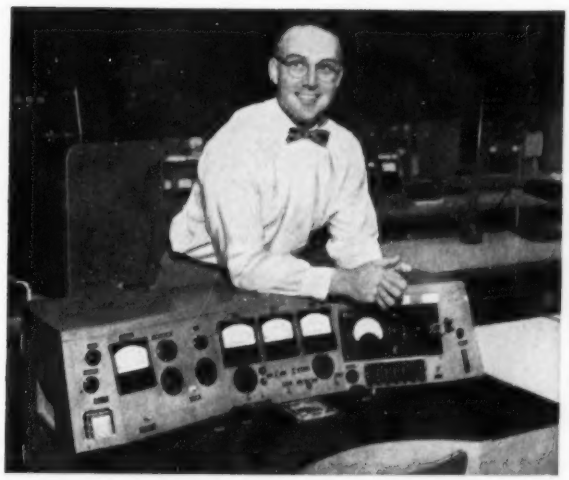
In the field of sports, Jim has limited his activities to some intramural basket ball, and what he calls "Saturday-and-Sunday-Golf." He wouldn't reveal his usual score, but we can charitably ascribe this to modesty.

Jim is also well rounded in more studious pursuits. He enjoys his Liberal Arts course very much, and even admits with a wry grin that he does much better in them then in his technical courses. As a freshman he "bombed" Psych 101; he says, "I was young and innocent, and I did a fantastic amount of work!" When two years older and less innocent, he still managed to get 100 on an American Ideals prelim. Right now he is taking Russian Literature and is very enthusiastic about the course and professor.

Where is he going from here? Jim is considering two possibilities. The first is the Nuclear Power Engineering option which the EP school is now offering. The other is solid state physics, which would necessiatate going on for a Ph.D.

No matter which he chooses, however, there is no doubt that Jim Larrimore will make a name for himself not only in the world of applied science, but also in the community about him. His life should be a full, interesting, and successful one.

Young engineers making news at Western Electric



Richard C. Shafer, B.S. in mechanical engineering at Lehigh, was one of 16 engineers assigned to one of Western Electric's toughest post-war projects — developing manufacturing techniques for mass-producing *(with great precision!)* the tiny but amazing transistors which are already causing a revolution in electronics.

Western Electric's primary job — which goes 'way back to 1882 — is to make good telephone equipment that helps Bell telephone companies provide good service. It's a very big job — and a very important one — which calls for the pooling of varied types of engineering skills.

New manufacturing processes and methods are constantly required to produce better telephones, better central office equipment, better wires and cables, new types of electronic equipment to keep pace with the nation's ever-growing need for more and better telephone service at low cost.

In addition to doing our job as manufacturing unit of the Bell Telephone System, Western Electric is busy producing many types of electronic equipment for the Armed Forces. Here again, young engineers of varied training are doing important work in connection with the manufacture of radar fire control systems, guided missile systems and special military communications systems.

Paul J. Gebhard, B.S. M.E. at the University of Maryland, was one of a team that helped develop Western's new electroforming process for coating steel telephone wire with copper, lead and brass in one continuous operation. His job: to develop conductor resistance-annealing equipment and electrolyte filtration and circulating systems.

Bobby L. Pettit (at right), an E.E. from Texas A. & M., is one of several hundred members of Western Electric's Field Engineering Force. These F.E.F. men can be found all over the world — working most closely with the Army, Navy and Air Force — advising on the installation, operation and maintenance of complex electronic equipment made by W.E.

Hitch your future to a HELICOPTER...

it's going places and so can you

Although acclaimed everywhere as the world's most versatile aircraft, helicopters have had only a few short years to prove it. A product of your generation, they are . . . in fact . . . *younger* than you are.

Like you, they face a future that is at once challenging and promising, but the exciting details of that future remain to be discovered and worked out.

If you expect to be a graduate engineer shortly, all this can be most important to you. Sikorsky Aircraft, the company that pioneered helicopters, is moving into high gear . . . going all out to keep pace with ever-increasing military and commercial requirements. Quite naturally, the world looks to Sikorsky to design and build the helicopters of tomorrow. And for the creative engineering, for the imagination, for the technical abilities that the future will demand . . . Sikorsky Aircraft looks to *you*.

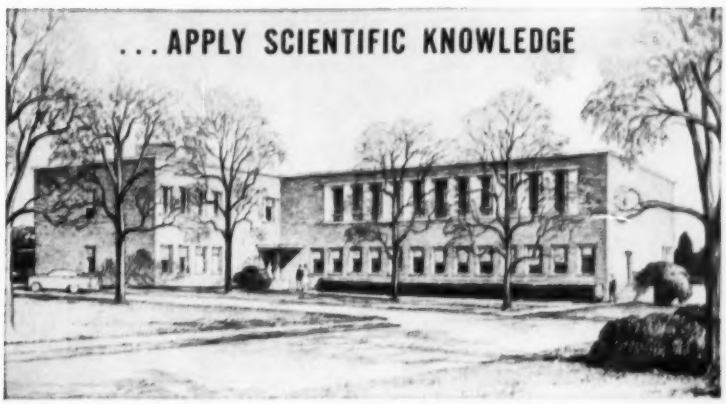
We would welcome the opportunity to give you a more complete picture of our company . . . and to see if there is a place in that picture for you. The next step is yours. Take that step and write to Mr. Richard Auten, Personnel Department.

SIKORSKY AIRCRAFT

ONE OF THE DIVISIONS OF UNITED AIRCRAFT CORPORATION • Bridgeport 1, Connecticut

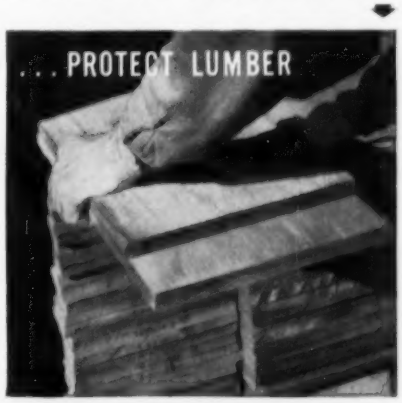
HOW HERCULES HELPS...

IN HEAVY TRAFFIC AREAS like this, floor tiles must be built to take a beating. Whether the tiles are of the rigid, mastic type or flexible flooring based on rubber or vinyl, Hercules Neolyn®, Mastolyn® or Staybelite® resin can contribute to lower processing costs and better wearing qualities. The wide variety of properties offered by these resins assures that there is one best suited for every floor tile formulation.



MORE THAN 17,000 VOLUMES of scientific literature and tens of thousands of company research reports will be housed in this new $1,000,000 Technical Information Center at the Hercules Experiment Station near Wilmington. In addition, the structure will provide quarters for the many technical specialists who serve the scientific information needs of the Hercules research staff—making the Center one of the nation's most complete information services to an industrial research organization.

WHICH HAD THE TREATMENT? The clean, unsplintered piece has been treated with Hercules Paracol® wax emulsion, making it possible to use every inch of lumber that has been pre-cut at the mill. The untreated piece (top) is badly "checked" and a portion of the end must be discarded before it will be suitable for use.



GSS-13

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HERCULES

CHEMICAL MATERIALS FOR INDUSTRY

College News

Placement Service Aids Job Selection

Over 500 industrial representatives will visit the campus during February and March to interview this year's 250 graduating engineers. Although this lopsided ratio is simply another example of the current intense demand for engineers, it presents many problems for the University Placement Service whose task it is to co-ordinate all Cornell placement activities. Unlike many students, the Service has been preparing for its mid-year examinations, which occur during the early spring recruiting season, throughout the fall term.

The writer learned the extent of these preparations last November when he visited the Service's office in Day Hall. When he arrived, the directors, Mr. John L. Munschauer, '40, was answering a long distance telephone call, one of several he was receiving each day concerning arrangements for the spring recruiting season. Most of the arrangements were completed about January 15, at which time the Service issued a schedule to all fifth year engineers indicating when the various companies would be on campus. With the schedule as a guide, each student, together with his advisor, then selected several representatives he wished to see. These interviews were then arranged through the Placement Service and the Office of Student Personnel of the College of Engineering.

Although placement interviews represent the culmination of five years of educational preparation, they need not be as painful as one interview a few years ago was for a notably shy engineer. At the appointed time the student knocked softly on the door of the interview room. The voice of an experienced recruiter called out "Come in" from within. The student responded, but even more timidly than he had knocked. The interview was a short one. In a few seconds, much to Mr. Munschauer's surprise, the young man burst out the door, slamming it behind him. Then, to Mrs. Munschauer's even greater astonishment, the boy re-entered the office, this time with a more self-confident, even arrogant air. Upon later questioning, the recruiter explained that he had first told the student that there was little point in continuing the interview because he would not hire anyone so lacking in self-confidence; however, when the boy exhibited such a capacity for rapid learning, he was immediately hired.

The Placement office also performs a number of other services for which no direct charge is made. For instance, it distributes employment brochures about smaller companies who do not send representatives. It also maintains a file of opportunities for summer work. In general, these consist of summer camp and hotel work for underclassmen, together with more technical types of employment for juniors and fourth-year engineers. Most such work is applied for by mail, although some, especially that having career significance, is obtained by interviews on campus. Still another service is provided by a branch office in New York City which concentrates on assisting alumni. It is not recommended, however, that graduating engineers postpone their interviews because of military service. On the contrary, the Service has observed that many students returning from their years in the armed forces have joined the same firm which agreed to hire them while they were still at Cornell.

Before the Placement office was established, recruiting was carried out independently in each school. Even prior to 1900, several pioneers in this field, notably the Westinghouse Electric Corporation and the Bell Telephone Company, annually sent representatives to visit the individual professors and to discuss their undergraduate students. The scarcity of work in 1933 prompted the establishment of the Service,

whose first director was Mr. Herbert H. Williams, now Director of Admissions. The rising demand for engineers since then, however, has actually increased the Service's work load as compared with the lean years of the 1930's. In fact, the competition among employers has actually become so keen that only those offering high starting salaries have much of a chance. While E. I. du Pont sends two representatives for a week and General Motors Corporation sends one for another week, many smaller companies have become discouraged, and have given up after a number of years of poor student responses.

The Service's task is also made more difficult by the pressures which harass most public relations agencies; in this case the pressures are applied by the employers anxious for new material and students anxious for opportunities. One of the extremes is perhaps exemplified by the motion picture company which was looking for a new Tarzan. After stating the desired physical specifications such as height, weight, build, and appearance, and various skills, such as swimming, the company made the recruitment task somewhat easier by stating that acting experience was not needed, or even particularly wanted! At the other extreme is the case of a certain ambitious student, who, after inquiring about various expanding industries, asked Mr. Munschaurer "What new fields remain undiscovered?"

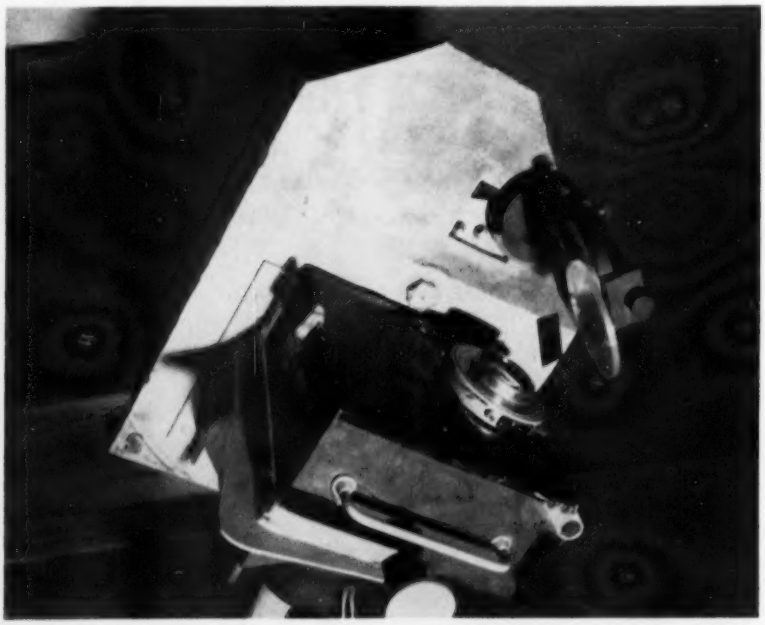
Race Track Spectograph

A "racetrack spectrograph" that photographs gases traveling in shock tubes at 17 times the speed of sound and at or above temperatures which exceed those of the sun's surface have been developed by Richard Rosa, a student in Cornell's Graduate School of Aeronautical Engineering.

A shock tube is placed in front of a drum camera in which film is rotated as fast as the image of the wave travels. The film "chases" the image of the wave as it moves along the tube and photographs the history of gas particles in the tube. This eliminates many of the difficulties, encountered in making exact measurements of properties of gases, which arose because shock waves travel an inch in as short a time as a few millionths of a second.

In the tube a diaphragm of copper separates high and low pressure regions. When the diaphragm is burst the gas from the high pressure region rushes along the tube like a piston, pushing the low pressure gas ahead of it, thus creating high temperatures and reproducing physical conditions that sometimes, oc-

Race track spectrograph measures high velocity gas spectra.



cur in stars or in shock waves that form around supersonic missles.

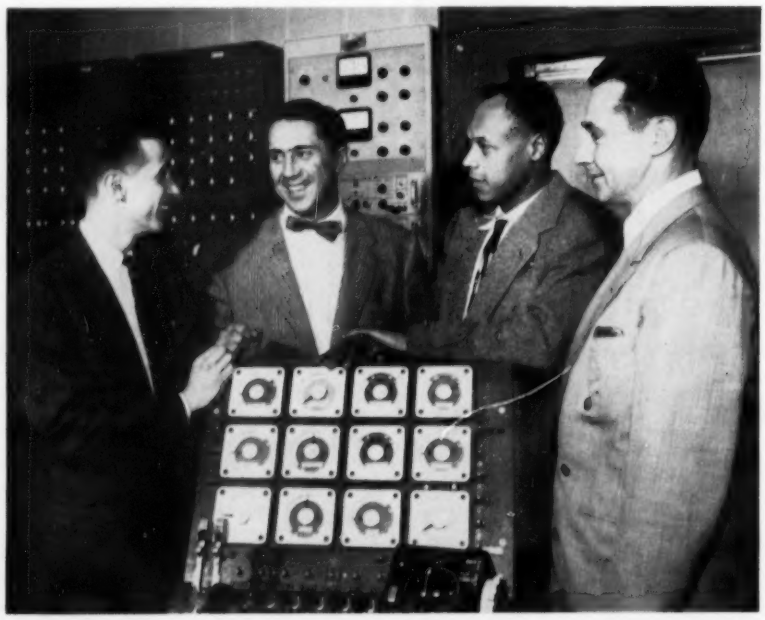
Results of the studies regarding how magnetic fields affect electrically conducting gases is adding basic knowledge to a new branch of physics called "magnetohydrodynamics." This knowledge may some day be applied to rocket propulsion and other problems of high speed flight.

F-100 Super Sabre

Cornell Aeronautical Laboratory's stability and control research represents a major portion of that work coordinated and performed in the country. The work basically consists of the study and improvement of handling qualities of latest type aircraft. Problems in stability and control can affect performance of an aircraft in take-offs and landings, maneuvering and even in its critical role as a stable bombing and gun platform.

The F-100 is a high priority project of the U. S. Air Force. The fighters are in production in Los Angeles and tooling has been underway at the Columbus, Ohio plant of North American for several months. The ship was grounded recently pending complete investigation of three crashes. The grounding order was later lifted providing modifications were made in the airplane.

The F-100 holds the world's top speed record at sea level, 775,147 mph, set by Lt. Col. F. K. (Pete) Everest at Salton Sea, California, Oct. 29, 1953. At higher altitudes where jet engines operate better, the Super Sabre is expected to go faster. The ceiling is rated above 50,000 feet and the range is over 1,000 miles.



CORNELL ALUMNI MEET—North America Aviation employees Jan Rus (second from left), and Con Grant (right), both 1949 Cornell graduates, get together with former Cayugans Marshall Lapp (left), 1952 grad, and Meredith Gourdine (second from right), 1951 grad, during a student tour of the company's Downey (Los Angeles county) plant recently. Lapp and Gourdine are presently doing graduate work at the California Institute of Technology in Pasadena, Calif. As a member of the U.S. Olympic team, Gourdine won second place in the broad jump at Helsinki, Finland in 1952. He is retained by North American as a consultant in guidance analysis. They are grouped around the console of a flight simulator for airplanes and missiles.

N. T. Avant, aerodynamicist (left), R. R. Heppe, Aerodynamic Department head (center), and C. F. Branson, aerodynamicist, discuss wind tunnel tests to determine transition height of a supersonic superiority fighter.

Hovering to High Speed Flight:

Lockheed Aerodynamics Projects Offer Advanced Problems

Aerodynamics Engineers at Lockheed are working on advanced problems that cover virtually every phase of aircraft. The full scope of their work can be seen in the wide range of aerodynamics problems encountered in Lockheed's diversified development program.

Among the advanced problems are:

1. Determine means of controlling a supersonic vertical rising aircraft through the transition flight stages from horizontal to vertical flight.
2. Determine the dynamic response of supersonic aircraft in high rate rolls by application of five degrees of freedom analysis procedures.
3. Study optimum operating descent procedures to minimize costs on a new turboprop commercial aircraft.
4. Conduct and analyze wind tunnel research on new and radically different external radomes to be carried at high speed by early warning aircraft.
5. Perform generalized aeroelastic analysis combining structural and aerodynamic knowledge to determine optimum lateral control devices for use on very high speed, low load factor aircraft.

These—and many other—significant problems have created new positions for experienced Aerodynamics Engineers and Aerodynamicists in Lockheed's expanding program of diversified development.

You are invited to contact your Placement Officer for a brochure describing life and work at Lockheed in the San Fernando Valley.

Additional information on these problems and data on Lockheed's Aerodynamics Division is available to interested engineers. Address inquiries to R. R. Heppe.

LOCKHEED AIRCRAFT CORPORATION

CALIFORNIA DIVISION BURBANK **CALIFORNIA**

Air Photos

(Cont'd from page 12)

mizes the amount of field work required for a thorough investigation. The new result is mapping of sufficient accuracy and at less cost than previous methods.

Archaeology

Archaeologists have found aerial photographs valuable in locating ancient construction. In England, the traces of Roman roads and villages, which were indistinguishable on the ground, have been located by aerial photographs due to differences in soil tone patterns. In the jungle areas of Central and South America, ancient temples have been discovered in a fraction of the time a ground exploration would have taken, and in the Southwestern part of the United States, the ruins of ancient Indian villages have been identified from airphotos.

Education and Research

Well over 100 universities offer some limited exposure to the use of aerial photographs in geography, geology, forestry or engineering, but very few schools offer a comprehensive sequence of courses. Among the schools with a well developed program of undergraduate and graduate studies in the field are the School of Civil Engineering at Purdue University and the Cornell Center for Integrated Aerial Photographic Studies. Only Cornell has an integrated center with professors from Agriculture, Engineering, Architecture, and Geology on its staff.

All three branches of the service offer training in photo interpretation for both enlisted men and officers with courses ranging in length from ten weeks to thirty-one weeks. The Air Force course for its officers places emphasis on the analysis of industries and military installations and their operations. The course also includes about 12 weeks of radarscope interpretation of ground features.

A number of universities, including Cornell, Purdue, Rutgers, Boston, and Wisconsin, conduct research in airphoto interpretation, often in connection with state highway departments, and publish pamphlets which are of significance in their field.

Only a limited number of textbooks are available on the subject at present. Most of those which do exist serve only to point out the fields of usefulness of aerial photographs and do not actually attempt to instruct in the methods of analysis and interpretation which must be used in a thorough interpretation. Purdue University has published an excellent but unillustrated textbook titled "Airphoto Interpretation of Soils and Rocks for Engineering Purposes" and Professor Belcher of Cornell is now preparing a textbook which should be the best available upon its completion.

The uses of aerial photography in exploration, mapping, planning, and construction are realized by too few persons at present and it is hoped that the publication of this article will help stimulate a greater awareness of the potential of this expanding science.

Technibriefs

Jet Fuels

Increased jet engine powers necessitated by supersonic flight have made thermally stable fuels one of the biggest problems in jet flying today. To help produce such fuels, the ERDCO Engineering Corporation developed the Erdco Jet Fuel Coker for evaluating jet fuels under prescribed conditions.

In the Erdco cooking unit, the test fuel is pumped through an angular heat exchanger. Hot fuel then passes through a sintered steel precision filter. Fuel flow rate, fuel temperature, and filter temperature can be varied over a wide range to control test severity. Insoluble sediment which is formed during the heating operation deposits on the filter. The time required to achieve a given pressure drop across the filter is a measure of fuel stability. Visual observation of the heated tube is made to estimate heat exchanger fouling tendencies.

A typical jet fuel test might be run with the following conditions; a flow rate of 4 pounds per hour, fuel temperature—400°F., a filter temperature of 500°F., and a fuel pressure of 150 pounds per square inch gauge. Fuel stability is then determined by operating until a pressure drop of 25 inches of mercury is obtained across the filter or until 300 minutes have elapsed.

Light Bulb Improvement

General Electric has announced "the greatest single improvement in incandescent light bulb performance in 42 years" which will mean an increase of 6 to 15% in light output for the same amount of electricity. Ultimately, the benefit to American consumers in the form of increased light can amount to more than $100,000,000 annually.

The increased light output is achieved by the following steps: improving the tungsten filament by making basic design changes; altering the mount structure so that the filament is positioned lengthwise (axially) in the bulb; and substituting for the first time coiled-coil filaments for singly coiled ones in lamps of 30 watts and larger.

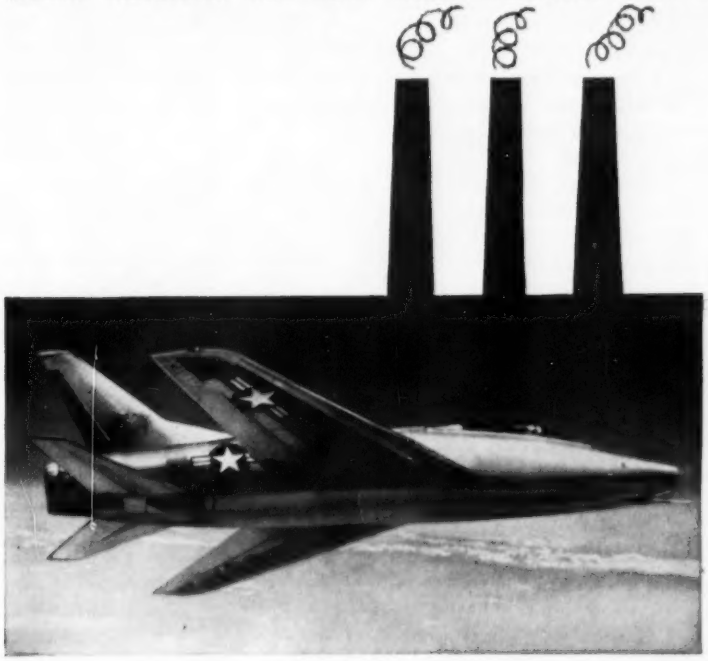
Axial positioning of the improved filament, the most dramatic visual change in the improved lamps, does two things to increase light output: first, it permits the filament to burn at higher temperatures which enables it to produce more light without shortening its life; and secondly, it causes bulb blackening to concentrate in a smaller area which permits more light to get out.

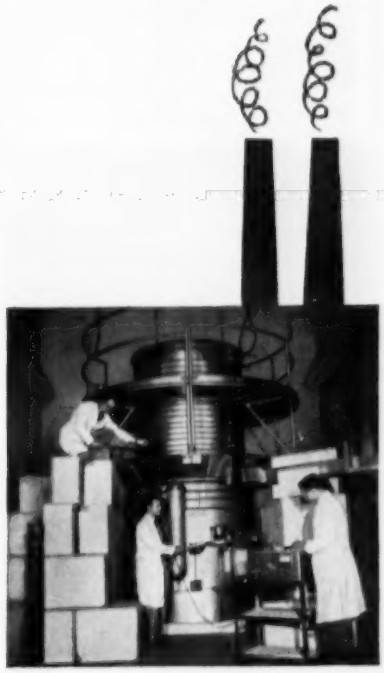
As a result of these construction changes, lamps of 300 watts and larger will have an increased output of 15%. For example the 750 watt bulb will produce an average of 21.6 lumens per watt compared with present 750 watt bulbs whose efficiency is 18.9 lumens per watt. Smaller household bulbs will have an increased light output of 6% when placed in production.

Medical Research Center Began

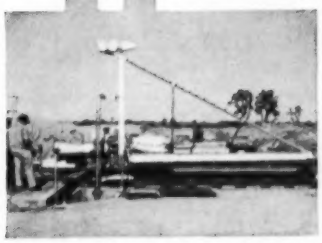
Lewis L. Strauss, Chairman of the United States Atomic Energy Commission, has anounced that a medical research center, including a nuclear reactor designed specificially for medical research and treatment, will be constructed at Brookhaven National Laboratory. Brookhaven, one of the AEC's major reseach laboratories, is op-

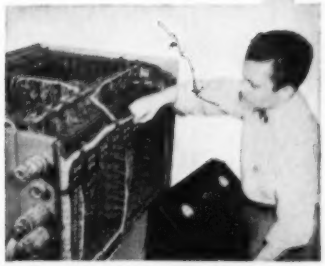
NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD





DIVERSITY CREATES OPPORTUNITY





Although best known for design and production of world-famous aircraft like the Korea-famed F-86 *Sabre* Jet and the new, record-smashing F-100 *Super Sabre* . . . North American Aviation also offers engineers excellent opportunities in other technical fields.

North American needs engineers with imagination to help design and build the aircraft of the future. Other fascinating careers are created daily in its rapidly developing guided missile, jet, propulsion systems, electronic and atomic energy programs.

When you are ready to enter the engineering profession, consider the well-paid opportunities at North American. Meanwhile, write for information on your future in the aircraft industry.

Contact: **Your College placement office or write:**

Engineering Personnel Office
5701 West Imperial Highway,
Los Angeles

12214 South
Lakewood Blvd.,
Downey, Calif.

North American
Aviation, Inc.
Columbus 6, Ohio

ENGINEERING AHEAD FOR A BETTER TOMORROW

NORTH AMERICAN AVIATION, INC.

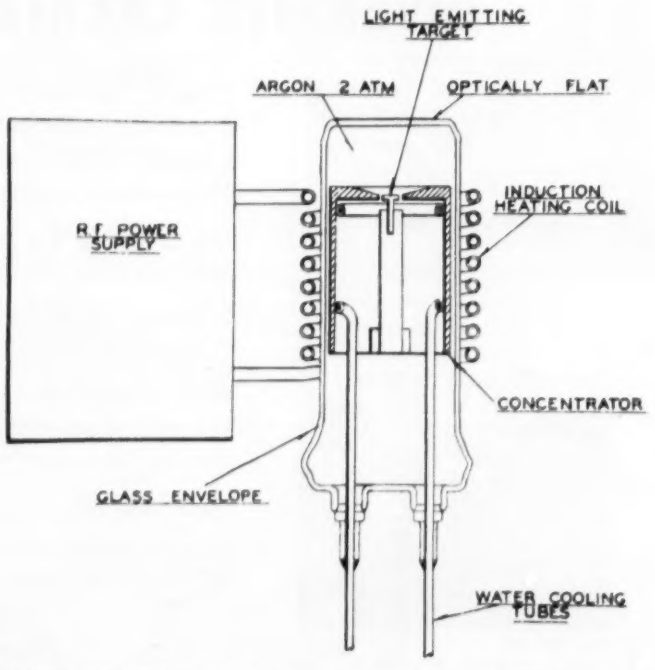
erated by Associated Universities, Inc., of which Cornell is a member.

Scheduled for completion in two years, at a cost of $6,000,000 exclusive of design and engineering, the new facility will house a nuclear reactor, a research hospital, an industrial medicine branch, and research division in medical physics, pathology, microbiology, biochemistry, physiology and clinical chemistry, and will cover a gross area of 118,000 square feet (not including the new reactor) on the south side of the central laboratory area. As the medical program has grown, the buildings have become more inadequate to its needs as well as more difficult and costly to staff and maintain.

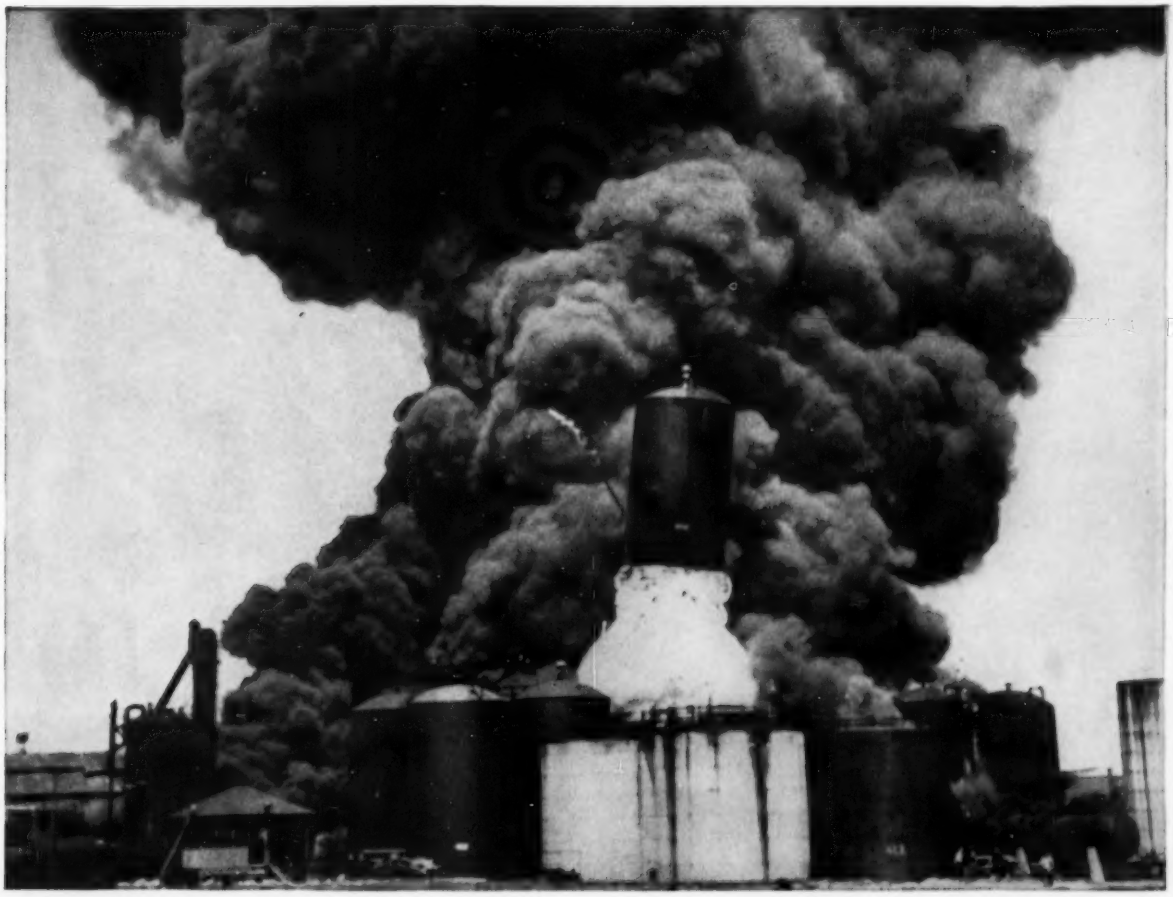
The medical reactor at Brookhaven will be one of the first two in the United States. In July the Commission announced that the University of California has filed license applications with the Commission for construction and operation of a medical reactor on the campus of the University of California at Los Angeles.

Medical research and treatment with neutrons have been conducted at Brookhaven since 1951 by utilizing the general purpose research reactor already in operation there. Treatment of patients at this reactor, however, requires that other work cease during the medical run, interrupting the research programs of other laboratory departments. The new reactor designed specfically for medical utilization will make available a source of neutrons for experimental work on brain cancer, as well as a number of special short-lived radioisotopes, permitting a much wider range of medical investigation than now under way.

In the past few years, as the need for more adequate buildings to house the medical activities became apparent, preliminary designs were drawn up by members of the Brookhaven Architectural Planning Department, in collaboration with the medical staff. Innovations developed as a result of these early studies will be reflected not only in the reactor but also in the hospital and research buildings.



RADIO FREQUENCY furnishes the power to make the new RF lamp burn more brilliantly than any other incandescent lamp ever used. Developed by Engineers of Sylvania Electric Products Inc., in cooperation with the Motion Picture Research Council, the RF lamp is used in motion picture printers to improve print quality and reduce processing time. Other applications for the lamp include color TV tube manufacture, medical research, radar and air traffic control, computers and projectors.



$500,000 skyrocket!

An exploding 2000-barrel asphalt tank booms skyward, showering flaming asphalt on adjacent tanks, to devastate this storage area. Once fire has gained such headway, it becomes extremely difficult to control.

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Book Review

STEELS FOR THE USERS, by R. T. Rolfe, O.B.E., F.R.I.C., F.I.M. 3rd Edition Philosophical Library, New York, 1956. 399 pp., illustrated $10

"Steel For the User" presents a clear explanation of considarations to be made in the selection of steels for industrial purposes. The text has been written for the layman or engineer who is lacking in a theoretical background of metallurgical knowledge so necessary in solving many of today's problems involving the use of modern steels. As stated on the jacket, "It's aim is to bridge the gap between science and practice for carbon steels in industry."

Although "Steels For the User" has been written in England, the utility of the text for American industrial practice has in no way been endangered. The content of "Steels for the User" is subdivided into such chapters as, Mechanical Quality and Assessment, The Effect of Composition upon Mechanical Quality, Heat Treatment of Steel-Theoretical Considerations, Fatigue Testing, Weld Testing and Treatment, and others. In addition, one hundred and thirty seven illustrations help to simplify the understanding of the written text.

"Steels for the User" is by no means limited to use by the practicing engineer but may serve as excellent reference material for the student in engineering, as well.

F4D, "SKYRAY"— only carrier plane to hold official world's speed record

A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier

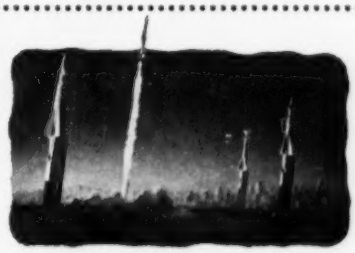
RB-66 — speedy, versatile jet bomber

A3D, "SKYWARRIOR"— largest carrier-based bomber

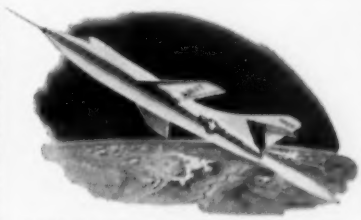
C-124, "GLOBEMASTER"— world's largest production transport

DC-7 "SEVEN SEAS"— America's finest, fastest airliner

Engineers: join this winning team!



"NIKE"— supersonic missile selected to protect our cities



D558-2, "SKYROCKET"— first airplane to fly twice the speed of sound

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STRESS and STRAIN...

Father to daughter: "Your young man approached me and asked for your hand, and I consented."

Daughter: "But father, I don't wish to leave mother."

Father: "Such feeling displayed by a child is admirable. Take your mother with you."

* * *

"How do two porcupines make love?"

"Very carefully."

* * *

The freshman ag. student was fascinated by the vast stretches of asphalt and concrete on the campus. Scraping his feet on the hard surface he said: "Well, I can't blame 'em for putting all the buildings here. The ground's too darned hard to plow anyway."

* * *

Pedestrian: A man who has two cars, a wife and a son.

* * *

Then there was the fellow who had a hobby of collecting rocks and putting them in his bathroom. He had rocks in his head.

* * *

A young woman tourist was spending the night in a Texas hotel. She was asking the clerk for sights to see of unusual interest.

"Well," said the clerk, "we have the only helium plant in the world."

"How wonderful. Is it in bloom now?"

* * *

Engineer: "Going around with women a lot keeps you young."

Second Engineer: "How come?"

Engineer: "I started going around with women when I was a freshman two years ago, and I'm still a freshman."

"I hear you've been to the school for stuttering. Did it cure you?"

"Peter Piper picked a peck of pickled peppers."

"Why that's wonderful."

"Yes, but it's heh-hard to work into an ordinary c-c-conversation."

* * *

THE LIFE OF A JOKE

Birth—A freshman thinks it up and laughs out loud, waking two Sophomores in the back row.

Age 5 minutes—Freshman tells it to a Senior, who answers: "It's funny, but I've heard it before."

Age 1 day—Senior turns it in to a college magazine as his own.

Age 2 days—Editor thinks it's terrible.

Age 10 days—Editor has to fill magazine, so joke is printed.

Age 1 month—Thirteen college comics reprint it.

Age 3 years—Seventy-six radio comedians discover it simultaneously and tell it accompanied by howls of mirth from the boys in the orchestra ($5.00 per howl).

Age 10 years—Professors start telling it in class.

* * *

Athletic: What can she do?

Literary: What does she read?

Society: Who are her parents?

Religious: What church does she go to?

Cornell: Where is she?

* * *

Now I lay me down to sleep
The lecture's dry, the subject deep;
If he should quit before I wake,
Someone kick me for goodness sake!

* * *

Prof: "When this room settles down, I'll begin the lecture."

Engr.: "Why don't you go home and sleep it off?"

For years the bum slept under bridges and in ditches. Then one day he switched to culverts and became a man of distinction.

* * *

Curious fly
Vinegar jug
Slippery edge
Pickled bug.

* * *

Policeman (to an intoxicated man who is trying to fit his key into a lamp post): "I'm afraid there's nobody home."

"Mus' be. Mus' be. There's a light upstairs."

* * *

Overheard in Dean's office — Dean to Engineering student: "Aren't you ashamed to be seen here so often?"

Student: "Why, I've always thought of this as a respectable place."

* * *

An E.E. stared into a mirror one morning and, noting his bloodshot eyes, resolved never to go into a bar again.

"That television," he muttered, is ruining my eyes."

* * *

A middle-aged woman lost her balance and fell out of a window into a garbage can. A Chinese passing by said: "Americans so wasteful. Woman good for ten years yet."

* * *

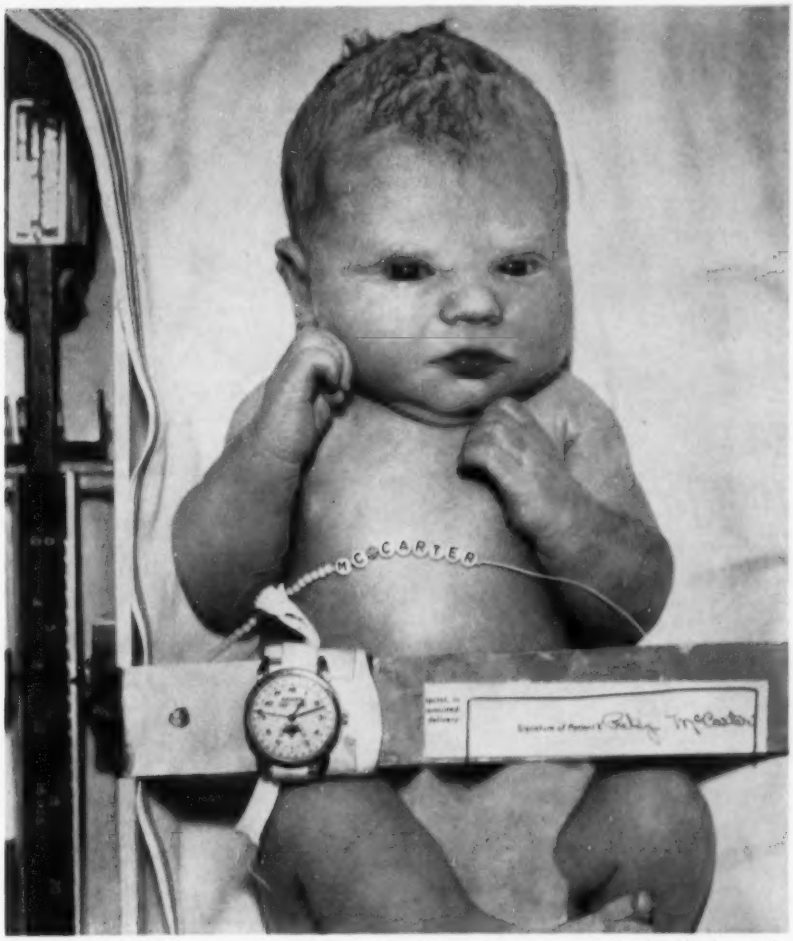
"I shall now illustrate what I have on my mind," said the professor as he erased the board.

* * *

"What's the matter," yelled the pedistrian at the driver, "are you blind?"

"Blind? I hit you, didn't I?"

PHOTOGRAPHY AT WORK—
No. 19 in a Kodak series



Teresa Jo McCarter, only minutes old—and still near mother—a photographic record makes identity certain.

Camera and film stand ready in the delivery room at San Antonio Hospital, Upland, California.

New eyes open on a bright wonderful world

—and photography makes identification positive, records vital statistics in life's first few minutes

At San Antonio Community Hospital, Upland, California, a positive means of *prompt* baby identification brings peace of mind to parents and hospital administrators alike.

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As it is for medical officials, photography is an equal boon to any engineer, scientist or industrialist who must record fleeting instrument readings. It captures action far too fast to see. It analyzes metal structure. It probes for hidden faults. It teaches technics. It makes sales. It is one of the greatest servants business and industry have today. It is helping improve design, speed production, control quality, increase sales and banish office chores.

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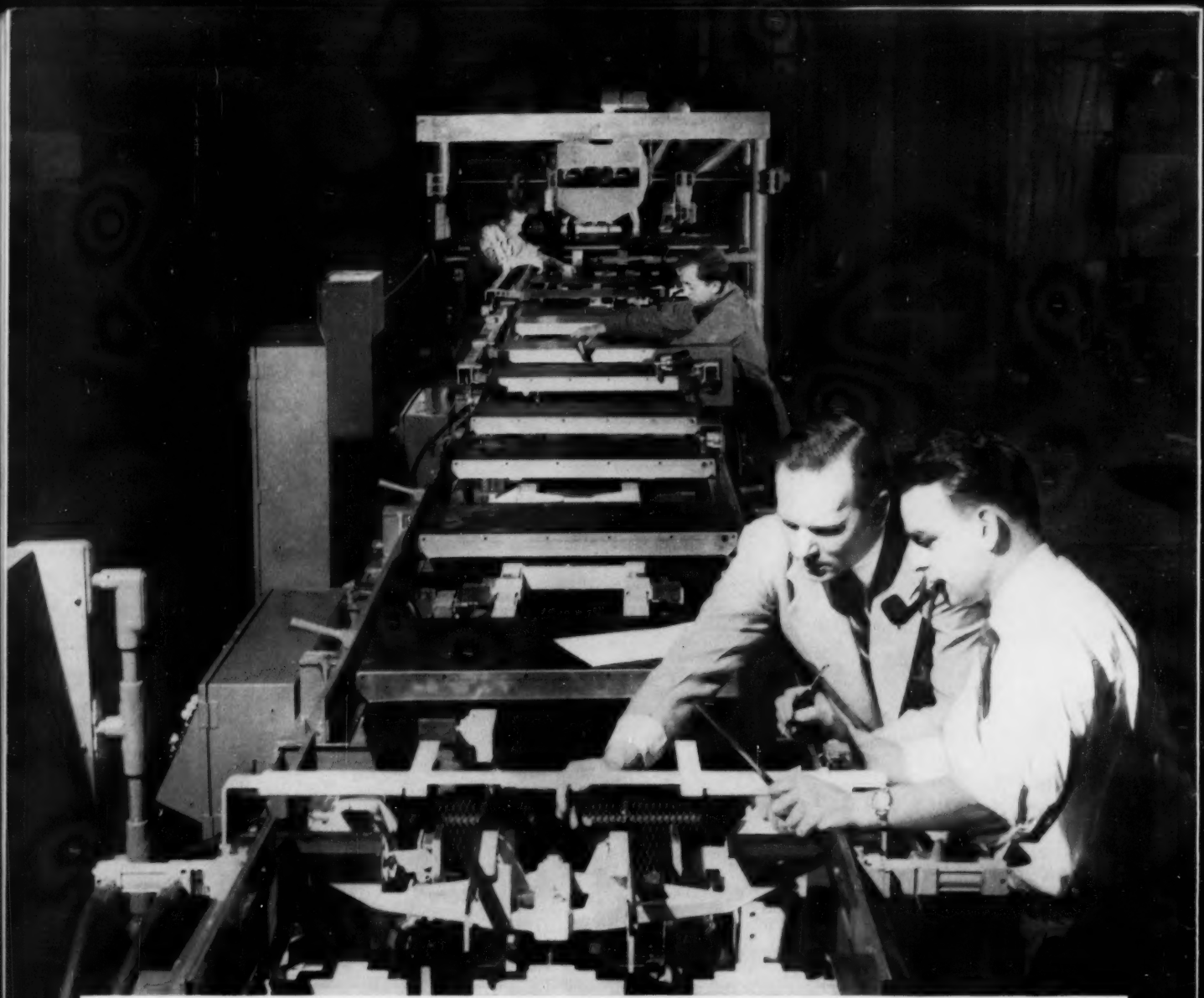

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Shown inspecting the door line, above left foreground, is Frank Foley, B.S. Industrial Engineering, Lehigh University.

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